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Engineering Library

The Engineer

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PUBLIC NOTICES

APPOINTMENTS BOARD OF THE Imperial College of Science and TECHNOLOGY,

SOUTH KENSINGTON, S.W. 7.

EMPLOYERS REQUIRING MEN who have received a thorough training in Science and Technology and who are Diplomates or Associates of the Imperial College or of one of its three constituent Colleges, are asked to MAKE USE of the SERVICES of the BOARD. No fees.

The Imperial College includes the Royal College of Science, the Royal College of Mines, and the City and Guilds (Engineering) College. The Associates of the Colleges receive thorough training in Science and Technology, including Aeronautics, Applied Optics and Optical Engineering, Biology, Chemical Technology, Chemistry (all branches), Engineering (all branches, including Metallurgy, Mining, Mining Geology, and Oil Technology), Geology, Mathematics and Mechanics, and Physics. 6253

Bombay, Baroda, and Central INDIA RAILWAY COMPANY.

The Directors are prepared to receive up to Noon on Thursday, 22nd December, TENDERS for the SUPPLY of :—

1. ROLLED MATERIAL for the CONSTRUCTION of BOGIE WAGONS.
2. PARTS for CONSTRUCTING BOGIE WAGONS.
3. AXLE-BOXES for WAGONS.
4. WHEELS and AXLES.
5. LAMINATED BEARING SPRINGS.
6. STEEL BOILER TUBES.

Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 10s. each (which will not be returned).

The Directors do not bind themselves to accept the lowest or any Tender.

S. G. S. YOUNG,
Secretary.

Offices: The White Mansion, 91, Petty France, Westminster, S.W. 1.
29.11.21. 6846

Borough of Portsmouth.

MAIN DRAINAGE.—CONTRACT No. 6. TO PIPE FOUNDERS.

The Corporation of Portsmouth is prepared to receive TENDERS for the SUPPLY of the following quantities of 42in. diameter CAST IRON PIPES, in accordance with the British Standard Specification Class "C" delivered free on rail at Fratton Railway Station, Portsmouth :—

STRAIGHT SOCKET PIPES, about 1350 Yards Lineal.
SPECIAL CASTINGS, about 80 Tons.

Form of Tender may be obtained at the office of the Engineer, Mr. C. Midgley Taylor, of John Taylor and Sons, 24, Victoria-street, Westminster, S.W. 1, upon payment of £2 (cheque only), which will be returned upon receipt of a bona fide Tender.

Forms of Tender will only be issued to bona fide pipe founders.

Sealed Tenders, endorsed "Main Drainage, Contract No. 6," addressed to the Town Clerk, are to be delivered at his office as or before 9 a.m. on Friday, 16th December, 1921.

The Corporation does not bind itself to accept the lowest or any Tender.

F. J. SPARKS,
Town Clerk.

Town Clerk's Office,
Town Hall, Portsmouth.
November, 1921. 6797

Metropolitan Water Board.

TENDERS FOR THE SUPPLY AND FIXING OF LANCASHIRE BOILERS, SUPERHEATER, PIPING, AND FEED PUMPS AT DEPTFORD, S.E. 8.

The Metropolitan Water Board invite TENDERS for the SUPPLY and FIXING of TWO LANCASHIRE BOILERS, SUPERHEATER, PIPING, FEED PUMPS, &c., at their Deptford Pumping Station, Brookmill-road, S.E. 8.

Forms of Tender, conditions of contract, specification, and drawing may be inspected without payment of fee at the offices of the Board, Room 182, Chief Engineer's Department, 173, Rosebery-avenue, Clerkenwell, E.C. 1, on and after Tuesday, December 6th, 1921.

Contractors desirous of tendering may obtain the necessary documents from Mr. Henry E. Stilgoe, M. Inst. C.E., the Chief Engineer, on production of an official receipt for the sum of £1 1s., which sum must be deposited with the Board's Accountant and will be returned on receipt of a bona fide Tender, together with all incidental papers.

Such payments and applications must be made between the hours of 10 a.m. and 4 p.m., Thursdays excepted (Saturdays, 10 a.m. to 12 noon).

Tenders, enclosed in sealed envelopes addressed to "The Clerk of the Board, Metropolitan Water Board, 173, Rosebery-avenue, E.C. 1," and endorsed "Tender for Boilers, Deptford," must be delivered at the offices of the Board not later than 10 a.m. on Wednesday, 18th January, 1922.

W. MOON,
Clerk of the Board.

Offices of the Board,
173, Rosebery-avenue, E.C. 1.
November, 1921. 6769

The Danish State Railways

invite TENDERS for the SUPPLY of about 20,000 TONS of RAILS and FASTENINGS.

Specifications and drawings can be obtained on payment of 15 Danish crowns on application to F. BANEKONTOR, Gl. Kongevej 1, 3rd, Copenhagen B., where Tenders will be received not later than 3 p.m. on the 4th of January, 1922. 6850

Manchester Corporation Waterworks.

The Waterworks Committee invite APPLICATIONS from fully qualified Engineers for the following APPOINTMENTS :—

RESIDENT ENGINEER during the construction of a service reservoir, who must have sound organising ability, experience in the control of men and in the construction of large reservoirs. Salary £700 per annum (inclusive).

ASSISTANT WATERWORKS ENGINEER, who must have similar qualifications and, in addition, experience in the administration of a large waterworks undertaking. Commencing salary £800 per annum (inclusive).

Applicants for either appointment must be Members or Associate Members of the Institution of Civil Engineers.

Applications, on forms to be obtained from the SECRETARY, Waterworks Offices, Town Hall, Manchester, must be sent in not later than the 19th December, 1921. 6854

PUBLIC NOTICES

London County Council.

TRAMWAY SUPPLIES, ELECTRICAL EQUIPMENT, &c.

APPLICATIONS are INVITED from firms, and particularly manufacturers, for PERMISSION to be PLACED on the LISTS of PERSONS and FIRMS from whom the Council from time to time invites Tenders for the supply of the undermentioned Fittings, Electrical and Mechanical Equipment and Spares, &c., required for the Council's tramways :—

Class No.
1. Car Motors, complete, and Spares.
2. Coils, Armature, Field, and Magnetic Brake.
3. Gear and Pinion Wheels.
4. Armature Re-winding and Repair.
5. Machined Bronze Bearings.
6. Machine-finished Articles (Brass, Gun metal, &c.).
7. Ditto Ditto (Iron, Steel, &c.).
8. Iron and Steel Drop Forged Stampings.
9. Iron and Steel Forgings.
10. Springs for Electric Car Trucks.
11. Iron Castings, Machined and not Machined.
12. Brake Shoes for Electric Car Trucks.
13. Malleable Iron Castings, Machined and not Machined.
14. Steel Castings, Machined and not Machined.
15. Truck Sides.
16. Castings, Brass, Gun-metal, Phosphor-bronze, Aluminium.
17. White Metal and Bearing Alloys.
18. Rolled Steel Bars for Magnetic Brake Shoes.
19. Channels, Angles, and Special Sections.
20. Tyres, Steel, for Tramcars.
21. Car Controllers, complete, and Spares.
22. Controller Fingers, Segments, &c.
23. Canopy Switches, Circuit Breakers, and Spares.
24. Rheostats, complete, and Spares.
25. Pressed Brass and Steel Articles.
26. Carbon Brushes for Tramcar Motors and Generators, &c.
27. Wire, Copper, Cotton Covered.
28. Cable, Electric.
29. Car Furniture and Fittings.
30. Moulded Rubber Articles.
31. Moulded Insulators (other than Rubber).
32. Fibre Articles.
33. Mica and Micanite Articles.
34. Press-spahn.
35. Insulating Varnishes.
36. Foundry Crucibles and Requisites.
37. Transfers, Coach Painters'.
38. Tyres, Rubber, for Motor Vehicles.
39. Electrical Line Equipment (Overhead).
40. Ditto Ditto (Conduit).
41. Copper Bonds.
42. Acetylene Generators and Lamps.
43. Welding Work.
44. Welding Plant and Electrodes.
45. Stone Crusher Rolls, Jaws, &c.

Applications must be made on the official form, copies of which, together with a statement giving further information on the subject, including the standard conditions of contract, may be obtained from the General Manager, Tramways Department, 23, Belvedere-road, S.E. 1.

In those cases in which Tenders are limited to manufacturers or producers, applications from agents, middlemen or dealers will not be considered.

Firms making application for inclusion in the selected list of tenderers will be informed in due course of the Council's decision in the matter.

Attention is drawn to the fact that, in cases in which the name of a person or firm has been placed on the Council's lists, it is not necessary for such person or firm to apply for form of Tender, as in all suitable cases forms of Tender will be sent from time to time as issued.

Applications for inclusion in the first lists of selected firms for the supply of the goods and articles enumerated above must be sent in not later than 31st December, 1921. Applications received thereafter will receive consideration in connection with future supplies.

JAMES BIRD,
Clerk of the London County Council.
6823

PUBLIC NOTICES

Shanghai Municipal Council.

ELECTRICITY DEPARTMENT.
CONSTRUCTIONAL ENGINEER AND ASSISTANT CONSTRUCTIONAL ENGINEER.

The Electricity Department of the Shanghai Municipal Council REQUIRES the SERVICES of a CONSTRUCTIONAL ENGINEER and an ASSISTANT CONSTRUCTIONAL ENGINEER, to Take Charge of the Design and Construction of New Buildings and Maintenance of Existing Buildings, for the Department. The work comprises both reinforced concrete construction and steel work construction, together with piling and rafts for foundations of large power-house buildings, sub-stations and machinery.

CONSTRUCTIONAL ENGINEER.—The duties of the Constructional Engineer will be to design all classes of engineering buildings and draw up complete specifications, and supervise the execution of the works by Chinese contractors or by direct Chinese labour. The Engineer appointed will be head of a sub-department and must be capable of organising and controlling a large staff.

ASSISTANT CONSTRUCTIONAL ENGINEER.—The duties of the Assistant Constructional Engineer will be to assist the Constructional Engineer in all his work and during his absence, if necessary, to act as his deputy.

Candidatia for the two appointments must have had thorough technical education and practical experience in large constructional works. They should have passed the examination for Associate Membership of the Institution of Civil Engineers or equivalent examination, and preferably have had experience abroad upon large public works contracts. Evidence as to technical knowledge and organising ability essential.

The salary of the Constructional Engineer will be 600 taels per month, and of the Assistant Constructional Engineer 400 taels per month. The present rate of exchange is about 4s. per tael. The first engagement will be three years and free first-class passage out and home again. Free medical attendance and superannuation are given.

Applications, in writing only, stating age with full particulars of training and experience, together with copies of recent testimonials and names of references as to personal character, to be sent to Messrs. PREECE, CARDEW and RIDER, 8, Queen Anne's-gate, Westminster, S.W. 1, not later than Friday, December 16th. 6847

Singapore, Straits Settlements.

WATER DEPARTMENT.

The Municipal Commissioners of Singapore REQUIRE TWO ASSISTANT ENGINEER-DRAUGHTSMEN, unmarried, age 25-35, on a three years' agreement, with possible extension. They must have a good education, a good training in a civil engineer's office, and must have a practical knowledge of surveying, levelling, and draughtsmanship, preferably with experience in the design and construction of new waterworks and appurtenant works and buildings. They would be employed chiefly on the design of waterworks, and would work under the instructions of assistant engineers. Salary, 5400 dollars for the first, 5880 dollars for the second, and 6360 dollars for the third year, paid monthly in dollars, the currency of the Colony, the value of the dollar being fixed at 2s. 4d. sterling. The pay of the appointment for the first year at this rate would be £630. In addition, there is, at present, a temporary allowance of fifteen per cent. on the salary, which is subject to revision at any time. Such local transport allowance as may from time to time be sanctioned by the Commissioners will be paid. Free passages will be provided, with half pay during the voyage out. Each of the selected candidates must pass a medical examination.—Applications, stating whether married or single, age, and place of birth, and giving details of education, training and experience generally, and in waterworks particularly, and referring to all the above requirements in detail, accompanied by copies (only) of testimonials, and also personal references, to be lodged with Messrs. C. C. LINDSAY and PEIRCE, MM. Inst. C.E., 180, Hope-street, Glasgow, Agents for the Commissioners (who will give further particulars if requested), not later than Tuesday, 13th December, 1921. 6708

PUBLIC NOTICES

Watford Urban District Council.

SERVICE RESERVOIR.
APPOINTMENT OF CLERK OF WORKS.

The Watford Urban District Council invite APPLICATIONS for the APPOINTMENT of a CLERK of WORKS for the Construction in Concrete of a Two Million Gallons Service Reservoir and Pipe Lines.

Candidates must be thoroughly qualified by actual experience in the supervision of similar work. They must have a sound practical knowledge of materials, construction, setting out, and in the testing of cement.

The Clerk of Works appointed will be required to be on the works during all working hours.

The salary will be £5 per week, paid monthly.

Applications, endorsed "Clerk of Works," stating age, experience, when at liberty, and accompanied by three testimonials, to be delivered to the undersigned not later than Wednesday, 14th December, 1921.

W. HUDSON,
Clerk and Solicitor.

Council Offices, Watford. 6798

The National Foremen's Association of the ENGINEERING AND ALLIED TRADES.

(Registered under the Trade Union Act.)

An Association specifically formed to look after the interests of Foremen in their Supervisory Capacity.

All communications to Head Offices,
H. W. REID, 26, Belgrave-road,
General Secretary. Victoria, S.W. 1.
Ex.

SITUATIONS OPEN

WORKS SUPERINTENDENT.—The POST advertised by a Firm of Manufacturers of Electric Accumulators in THE ENGINEER, October 28th, has been FILLED. 6848 A

WANTED by a Firm of Old-established Steel Founders, YOUNG GENTLEMAN (with a public school education), with engineering knowledge, experience and influence, to act as full-time REPRESENTATIVE for the Sale of Steel Castings on commission basis in Manchester and Birmingham districts.—Address, P4478, The Engineer Office. P4478 A

WANTED, Experienced MACHINERY SALESMAN for India by Calcutta firm of engineers. Public school boy preferred. Five years' agreement, pay commencing Rs. 600 a month. No married men will be considered.—Write, Z. J. 288, c/o Deacon's, Leadenhall-street, London, E.C. 3, stating age, experience, and salary required. 6861 A

WANTED, Thoroughly Qualified and Up-to-date WORKS SHOPS ENGINEER, to Take Charge of Foundry, Pattern Shop, Smith and Boiler Shop, and thoroughly modern up-to-date machine tools employed on light and heavy general repairs and production. Must be good and efficient organiser, well accustomed to the handling of men.

Applicants to give full particulars of experience, age and salary.

Address, 6810, The Engineer Office. 6810 A

CIVIL ENGINEER, Fully Qualified, REQUIRED, for inspecting, reporting, improving heavy construction work progress various parts of the world. Good language essential. Splendid opening for gentleman possessing tact, discretion and experience big lay-out. Highest references required.—Communicate in first instance, together with copies record, which will be treated in strict confidence, by letter, to "SOLICITORS," c/o J. W. Vickers and Co., Ltd., 5, Nicholas-lane, E.C. 4. 6830 A

ENGINEER (About 35 Years) REQUIRED for Commercial position in a small old-established firm of Brassfounders and General Engineers at Maidstone, Kent. Sales and drawing-office experience absolutely essential, and applicants must also be able to confirm previous experience in an executive position. Salary £250-300.—Write in strict confidence, stating age, full particulars and when disengaged, Box 917, Potter's Advertising Agency, Imperial House, Kingsway, London, W.C. 2. 6822 A

ENGINEERS REQUIRED, Capable of Investigating any section of business. Applications received in strict confidence. Must give every detail of training.—Address, P4472, The Engineer Office. P4472 A

ENGINEER REQUIRED by SOCIETE HOPKINSON (Valves and Boiler Mountings), 94, Rue St. Lazare, Paris, as ASSISTANT to MANAGER. Applicants must be British, age 32 to 35, with technical and commercial experience, general knowledge Steam Power Plants, and good French.—Applications by letter, giving all particulars and salary required. 6858 A

GENTLEMAN REQUIRED by Important Industrial Company engaged in the production of non-ferrous metals, to Organise and Take Charge of a Department for Propaganda for Extending the Uses of well-known Metal in the engineering and allied trades. Sound engineering and technical training essential. Preference will be given to one with knowledge of German and French. Liberal salary offered to one possessing the necessary experience and qualifications.—Applications to be made in writing in the first instance to E. T., 64, Cannon-street, London, E.C. 4. 6849 A

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SITUATIONS OPEN (continued)

REPRESENTATIVE WANTED by Manufacturing Company making the highest quality of drawing office photo materials. Gentleman having real influence with important engineering and shipbuilding firms and able to effect good business can hear of a substantial arrangement. Particulars of connection and ground covered in strictest confidence.—Address, P4402, The Engineer Office. P4402 A

REQUIRED by Old-established Engineering Company in India, thoroughly trained and educated TECHNICAL ENGINEER, age 22/25, single, with university degree, B.Sc. preferred. Office experience in addition would be a recommendation.—Reply fully, stating age, salary expected, and experience, to Z. A. 947, c/o Messrs. Deacon's, Leadenhall-street, London, E.C. 3. 6741 A

SUPERINTENDENT.—REQUIRED by a Motor Manufacturing Firm in the London district, a General MACHINE SHOP SUPERINTENDENT. Must be thoroughly familiar with up-to-date methods of production and shop practice, and also used to producing work to fine limits. Must also have held similar positions previously.—Address, stating age, experience, and salary required, 6655, The Engineer Office. 6655 A

TESTER, with Thorough and Extended Experience in Testing Steam, Petrol, and Electrically Driven Centrifugal Pumps. Enclose full details of experience and state age, wage, &c.—Address, 6731, The Engineer Office. 6731 A

THE POWELL DUFFRYN STEAM COAL COMPANY, Limited, REQUIRE in January a WORKS MANAGER for a new works, to be employed on maintenance and general engineering work, including foundry, machine shops, and smiths.—Applications, giving full particulars, should be sent to the GENERAL MANAGER, Aberaman Offices, Aberdare. 6561 A

THE STANTON IRONWORKS COMPANY, Limited, near Nottingham, REQUIRE the SERVICES of a WORKS MANAGER for their Reinforced Concrete Pipe Works. Qualifications primarily ability to handle men, with some knowledge of concrete.—Reply in writing to above. 6614 A

TRAVELLERS or SUB-AGENTS WANTED for Lancashire, Yorkshire, and N.E. Coast, to carry Chemion Welding Powders for High-speed Steel, Iron, Aluminium, Patent Soldering Flux, Grip Pastes, &c. Must have good connection amongst engineers, motor works, shipyards, and foundries; must be energetic and good salesmen; commission basis. State in confidence present line carried and references.—Address, P4500, The Engineer Office. P4500 A

WORKS MANAGER REQUIRED for General Engineering work, London area, employing approximately 100 men. Must have knowledge of economical production with up-to-date methods, also knowledge of costing. Salary to commence £550 per annum.

State experience concisely and briefly, age, and when free, to Box 418, Maxwell Agency, 9, Curriter-street, London, E.C. 4. P4504 A

A GOOD DRAUGHTSMAN and ONE JUNIOR for Tracing REQUIRED.—Write, giving full particulars, age, experience, and salary, to A. E. P., 91, Fulham-road, S.W. 3. 6625 A

CENTRIFUGAL PUMPS.—DESIGNER WANTED, with extensive experience (latest practice) in high and low-lift types. State full particulars and qualifications, age, salary required, &c.—Address, 6753, The Engineer Office. 6753 A

JAMES CARMICHAEL and CO., Ltd., Ward Foundry, Dundee, REQUIRE LEADING DRAUGHTSMAN in connection with Uniflow Engine Design.—Applicants to state experience, age, and salary. P4468 A

WANTED, First-class FOREMAN, to Take Charge of Large Tool Department producing special Automatic Machines, also Jigs and Fixtures of high grade. Only men who have held a similar position need apply. Liberal salary to the right man. State age and qualifications.

Address, "FOREMAN," Wm. Porteous and Co., Advertising Agents, Glasgow. P4491 A

WANTED, First-class LOCO. SHED FOREMAN for large Iron and Steel Works on North-East Coast. Must be capable of carrying out all work in connection with Locomotive Repairs and Steam Cranes.—Address, giving full particulars of experience, age, and salary required, P4487, The Engineer Office. P4487 A

WANTED, a First-class WORKING ENGINEER, to Take Charge of Electric Plant and Machinery at a large Tannery, and able to control a small staff of men.

Apply by letter, stating age, salary required, experience, and when free, to RICHARD HODGSON and SONS, Ltd., Beverley. P4480 A

WANTED, FOUNDRY FOREMAN, Thoroughly experienced in high-class Light Engine Castings; must have special knowledge of gun-metal mixtures for heavy pressures, and all Admiralty test requirements; about 60 hands employed. None but thoroughly reliable experienced men with good references need apply. Good position for suitable man.—State age, wages, and full particulars to A. G. MUMFORD, Ltd., Culver-street Engineering Works, Colchester. 6833 A

FOREMAN.—REQUIRED for Large Motor and General Engineering Firm, FOREMAN, capable of taking charge of Grinding Department. Must have held similar positions previously and be thoroughly acquainted with all up-to-date methods of production and equipment.—Address, stating age, experience, and salary required, 6841, The Engineer Office. 6841 A

FOREMAN WANTED, Used to Tank and Plate Ironwork; one thoroughly up to his duties and used to control. State full particulars as to experience, &c., and wages required.—Address, 6835, The Engineer Office. 6835 A

LEDGER CLERK and CASHIER, Double Entry, and capable taking charge of office in small works, Eastern Counties. State experience and salary.—Address, 6844, The Engineer Office. 6844 A

SITUATIONS WANTED

BUYING ENGINEER.—The MANAGER of a Large B Engineering Works Purchasing Dept., who has an exceptionally wide knowledge of the markets of the country, DESIRES to NEGOTIATE NEW APPOINTMENT. Services available for New Year or possibly before.—Write, Z. M. 613, c/o Deacon's, Leadenhall-street, E.C. 3. 6826 B

CEMENT TECHNICIAN. Trained. Experienced home and abroad, can ACCEPT POST shortly. Abroad preferred.—Address, P4464, The Engineer Office. P4464 B

COPPER ROLLING AND WIRE-DRAWING.—SITUATION REQUIRED by Electrical and Mechanical Engineer as Manager or Assistant Manager of Department. Extensive experience in light and power installations, distribution, and maintenance work.—Address, P4470, The Engineer Office. P4470 B

ENERGETIC MAN (36) REQUIRES POSITION, home or abroad. Many years with noted Lancashire firm of engineers, supervising the erection of constructional steel buildings, &c.; capable of undertaking the supervision of any description of steel structure. Has had experience in America and Africa and can obtain excellent references.—DAVID BROWN, 3, Guelph-street, Liverpool. P4480 B

ENGINEER, 22 Years, Over 6 Years' Experience, general electrical plant, installation and testing, repairs, &c., DESIRES POSITION as ASSISTANT in Consulting Engineer's Office.—DURTNALL, 77, Linnell-road, Camberwell, London, S.E. P4507 B

Edward Arnold & Co.'s Book List.

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By F. R. C. REED, Sc.D., F.G.S.

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Special attention has been devoted to the deposits of economic importance, and a bibliography is printed at the end of each section of the book giving a selection of the more important references.

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By G. C. WELLS and A. S. CLAY, B.Sc. Second Edition. viii + 227 pages, 71 Illustrations. Small 8vo, 8s. 6d. net.

London: EDWARD ARNOLD & CO., 41 and 43, Maddox St., W. 1.

SITUATIONS WANTED (continued)

ENGINEER (32), A.M.I.E.E., B.Sc., DESIRES executive POST immediately; highly experienced., tech., commercial, with large firms 10 years, home and abroad; structural and maintenance a speciality. Will consider any offers, chief or assistant preferred.—Address, P4484, The Engineer Office. P4484 B

ENGINEER, with General Experience, Practical and technical, SEEKS BERTH in or near London. Erection, buying, charge drawing-office, design new plant, plant lay-out, assist consultant or factory maintenance.—Address, P4479, The Engineer Office. P4479 B

ENGINEER, with 17 Years' Experience of I.C. Motor vehicles, cars, lorries, tractors, caterpillars, &c., and 9 years machine tools and general engineering, will SHORTLY be OPEN to ENGAGEMENT in Technical or Managerial Capacity. Fully accustomed to latest methods of production and to control of men. Good commercial experience.—Address, P4477, The Engineer Office. P4477 B

ENGINEERS' INSPECTOR OPEN for FURTHER WORK; all classes during construction; any district.—J. LOWE, 97, Byron Avenue, London, E.12. P4317 B

HEAVY OIL ENGINE DESIGNER, with Wide experience in the design and manufacture, land and marine, is OPEN for ENGAGEMENT with good-class firm. Can give very highest references.—Address, P4465, The Engineer Office. P4465 B

INTERNAL COMBUSTION ENGINES.—ADVERTISER, having had exceptional experience in the design of semi-Diesel, Paraffin and Petrol Engines for all purposes, OFFERS his SERVICES to well-established firm.—Address, P4466, The Engineer Office. P4466 B

MANAGING DIRECTOR or GENERAL MANAGER.—MAN, with 25 years' experience, 12 in U.S.A., of general engineering and production, last job in England general manager of factory employing 1000 operatives, WANTS JOB of REORGANISATION or position where his knowledge of modern methods of production and control can be utilised.—Address, P4506, The Engineer Office. P4506 B

MARINE SURVEYOR, A.M.I. Mech. E., Shortly disengaged, hull and engine surveys, 1st Cl. Engr. B.O.T., D.O., tech., shop and sea experience, R.N. and Merc. Mar., French and Russian, DESIRES APPOINTMENT in similar or allied capacity.—Address, P4499, The Engineer Office. P4499 B

MECHANICAL ENGINEER, 13 Years' Good General experience as manager and foreman, also costing and travelling experience, SEEKS responsible POST any capacity.—Address, P4332, The Engineer Office. P4332 B

MECHANICAL ENGINEER, 20 Years' I.C. Engine experience, DESIRES responsible POSITION as Works or Sales Manager; good organiser.—J. TAUNTON, 25, Earlsthorpe-road, Sydenham, S.E. 26. P4476 B

REPRESENTATIVE.—ENGINEER, with Exceptional connection in the Midlands, DESIRES APPOINTMENT with first-class manufacturers of engineering products and motor accessories. Commission basis only.—Address, P4482, The Engineer Offices. P4482 B

WORKS MANAGER REQUIRES POSITION. Good experience in all branches of engineering; progressive, tactful organiser; good refs.—Address, P4462, The Engineer Office. P4462 B

YOUNG CIVIL ENGINEER (20), 3 Years College, A.C.G.I., SEEKS EXPERIENCE; remuneration not essential.—T. BOUND, Hormondes, Kent. P4497 B

YOUNG ENGINEER (22) REQUIRES POST as ASSISTANT to Works Engineer; 7 years' shop and D.O. experience; good educ.; excell. draughtsman.—Write, "E. W.," 35, Kingsley-street, S.W. 11. P4503 B

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For continuation of Small Advertisements see page iii

NOVEMBER.

A Naval Holiday.

IT was known that one of the subjects to be discussed at Washington would bear upon the reduction of warship building, but no one was prepared for the proposal made by Mr. Hughes, the American Secretary of State, on the opening day, November 12th, of the Conference. This proposal was no less than that the United States, Japan and Great Britain should agree to reduce their naval shipbuilding programmes for the next ten years, and that they should make the agreement so far retrospective that many ships already partially or nearly complete would be at once broken up. Three months after the signing of the treaty, the United States would possess only 500,560 tons of capital ships, Great Britain only 604,450 tons, and Japan only 299,700. For ten years no ships would be replaced, but at the end of that time the United States and Great Britain would each be allowed to build ships up to 500,000 tons and Japan up to 300,000 tons. If this programme is adopted, sixty-six ships, with an aggregate tonnage approaching two million tons, will have to be discarded. In the execution of this scheme, America expresses her willingness to scrap the principal vessels, fifteen in number, of her 1916 programme, and all her older battleships up to but not including the Delaware and North Dakota. These vessels would bring the number of the American sacrifice up to thirty big ships. Great Britain, for her part, is invited to stop all further progress on the four new "Hoods" and to destroy her pre-Dreadnoughts, second-line battleships and first-line battleships up to but not including the "King George V." class—in all, she would scrap nineteen capital ships. Japan, on her part, would abandon her present programme and would scrap or cease further work upon seven capital ships, of which some are far advanced, and would destroy some older vessels. She would thus give up seven new ships and scrap ten old vessels. This astounding proposal was very well received by all the Powers concerned, and although subsequent events have made it probable that modifications will have to be accepted, there is, so far, little doubt that very material reductions of naval armaments will be effected.

The Buxton Explosion.

THE explosion of locomotive engine boilers is fortunately a very rare occurrence, and the fatal bursting of one, belonging to the London and North-Western Railway, at Buxton, on the 11th of the month, has caused exceptional interest. This interest has been augmented by the decision of Major Hall, of the Ministry of Transport, to hold his inquiry, which was opened on Tuesday, 22nd, *in camera*. It is felt that such a course would not have been taken had there been no features in connection with the accident that could not be openly discussed. In these circumstances, however, it would clearly be improper to discuss the probable causes of the explosion, and we must do no more than repeat the few facts which were brought out at the inquest. From these facts it appears that the engine No. 134, an 0-8-0 of the mineral class, which had made a trip from Widnes on the preceding day, was due to leave for Oldham at 12.50. She had just been fitted with a new steam gauge owing to the complaint of a driver that the old gauge was reading too high. She was taken to the siding and coupled up to her train; the guard gave the signal to start, and apparently the train was just moving off when the boiler exploded with great violence. The evidence indicated that it was the barrel that failed, and if that is shown to be the case, then low water as the cause may be dismissed, for in that event the fire-box crown would have ruptured. The particulars available point to excessive pressure, and the remarkable fact that a previous driver had complained of the gauge reading too high, but had never suspected the safety valve of being defective, has no doubt occupied Major Hall's attention. Judging from the opinion expressed by experienced witnesses at the inquest on the 16th of the month, absolute trust is put in safety valves, and a driver is deemed right in regarding the safety valve as a more reliable indicator of pressure than the pressure gauge itself.

Aviation.

THE holding of an Aeronautical Exhibition in Paris during the month and of an international congress that extended its deliberations over nearly two weeks, was not so much a lesson of progress in aviation as of the importance which the French attach to this new arm of national defence. It is obvious that, regarded as a purely military machine, the aeroplane would make scarcely any progress at all, for the experience acquired would be limited, and it would be quite impossible to keep the aeroplane factories at work. The French Government therefore early saw the necessity of encouraging commercial air services, which under present conditions cannot be self-supporting, and by according subsidies it has the right to mobilise all the machines whenever necessary and to secure the services of a large number of highly skilled pilots. Little is said on the other side of the Channel about the development of a purely commercial type of aeroplane, which would be of no value as a military machine, and in the Grand Palais nearly all the aeroplanes could be employed for national defence, while one was specially designed and equipped for dropping torpedoes at sea. Nevertheless, the search for purely commercial types of aeroplanes must produce results of more or less benefit to military machines, which require a superiority in speed and rapidity in manœuvring. The demands for powerful engines of lighter weight will meet one of these requirements, and the remarkable results being obtained by a close application of aerodynamics to the study of wing sections must influence favourably the design of military aeroplanes. Such progress is only possible with the aid of experience gained in commercial services subsidised by the Government, until such time as new developments in engine construction will eliminate one of the principal financial disabilities. It was, at all events, interesting to observe at the Salon that the only new engine claiming to give the required results in the way of power for weight and fuel consumption was of British manufacture. It should not be overlooked either that the experiments with gliders offer promise of supplying valuable data, for, with a more extended knowledge of aerodynamics, results have been obtained in the way of sustained flight that would have been regarded as almost impossible only a few months ago.

The Kelham Beet Sugar Factory.

AT the beginning of the month the beet sugar factory which has been erected at Kelham, just outside Newark, by Home Grown Sugar, Limited, was put to work and commenced its first "Campaign." The installation has been designed to treat eventually 600 tons of beet per day of twenty-four hours during a campaign of 100 days continual day and night working, and, as a result, it is expected that some 8000 tons of sugar will be produced annually. In addition to the sugar, by-products, consisting of some 3000 tons of dried beet pulp, 1800 tons of molasses, and a large quantity of lime waste, which is valuable for manurial purposes, will, it is anticipated, be obtained. The factory building stands on an area of land which extends to some 41½ acres, and which is in close proximity to the river Trent, from which it will abstract some 2½ million gallons of water per day for manufacturing purposes. About 300,000 gallons of water per day will also be taken from the town mains for use in those operations in which pure water is essential. For the initial campaign it was decided that 20,000 tons of roots would be sufficient, and that quantity has, we understand, been grown by some 425 farmers in the immediate neighbourhood and in the surrounding districts, some of it having been grown on the company's own estate. The beet produced near the factory will be carted or brought into the factory by lorries, but the large majority will either arrive by water—and to receive it a concrete wharf, which is connected to the factory by a short railway, has been constructed on the bank of the Trent—or by railway, there being direct connection with a main line of the Midland Railway and sidings which will accommodate 150 full-sized railway wagons at one time. Having regard to the fact that continental engineers have had so much experience in connection with the machinery and apparatus necessary for the extraction and production of sugar from beet, it was decided to entrust the contract for the equipment of the factory to a French firm—the Compagnie de Fives-Lille. The buildings and the other engineering works in connection with the factory, which are of an extensive character, are, however, all of British design and construction.

New Power Station at Runcorn.

BY the opening last week of the Mersey Power Company's new generating station at Weston Point, near Runcorn, the available supply of electric energy in the large industrial area within the Mersey and West Lancashire Electricity District will be considerably augmented. Formerly, the current for this district was produced by an interesting plant owned by the Salt Union, the chief object of which was to make salt. For this purpose, a large amount of low-pressure steam is required for the vacuum plant, and Mr. G. W. Malcolm, the engineer and managing director of the Salt Union, conceived the happy idea of putting down a turbine installation for generating electricity for use in the company's own works and the surrounding neighbourhood, while utilising the exhaust steam in a triple effect vacuum plant. This plant proved adequate for both purposes until the war, when the demand for current in the adjacent chemical factories became excessive. Current was sold in bulk to the Mersey Power Company, which, in turn, retailed it to the consumers. The company was therefore compelled to erect a new and up-to-date power station, which, while capable of dealing with the present demands, is so laid out as to be readily extendable to a capacity of 100,000 kilowatts as and when required. This new station at Weston Point is designed to comply with the conditions laid down by the Electricity Commissioners, and has a present capacity of 25,000 kilowatts derived from two Parsons turbo-generators. Current is generated at 50 cycles, 6450 volts, and there is an outdoor step-up transformer station by which the pressure is transformed to 33,000 volts for transmission to Ellesmere Port. The coal and ash-handling plants embody the most recent improvements, and it is expected that when in full running order, the steam consumption will be rather less than over 10.15 lb. per kilowatt-hour. The company has been particularly happy in the selection of a site for the works, water to an almost unlimited extent being obtainable for condensing purposes from the Manchester Ship Canal, thereby obviating the employment of cooling towers, while fuel can be brought right up to the boiler-house by means of the company's own railway sidings. With these facilities, and a good load factor, the station opens its career with excellent prospects of success.

The Motor Car Shows.

THE recent exhibitions of motor cars held simultaneously at the White City and Olympia formed collectively the largest Show of the kind which has ever been held in this country, and, considering the general industrial depression, the trading results are said to have been quite satisfactory. The chief business done was in connection with smaller types of cars, many of which were shown for the first time. It was instructive to observe various ways in which the makers of the small cars are attacking the problem of producing really serviceable machines for the smallest possible outlay of money. Perhaps the chief points of difference were in connection with the engine and transmission gear, and it was remarkable to see one of the oldest and most reputable firms reverting to a horizontal engine with two opposed cylinders after having abandoned that type of motor many years ago. In connection with the motor mechanism, the most novel feature of the Show was an oil-cooled engine of the "V" type, the cylinders of which are situated in the crank chamber which is flooded with oil. A growing tendency noticeable on the part of the builders of the more powerful cars is to adopt four-wheel braking, and it would appear that before long brakes on all the road wheels will become fairly general. With the general speeding up of road traffic, too much attention cannot be given to brake design and construction, and obviously four brakes should be better than two, provided that they do not introduce complications which are liable to get out of order. Front wheel brakes were taken up by several leading British firms some years ago, but they were not generally satisfactory and accidents resulted, which led to their abandonment.

The Four Ships.

ON Friday, the 18th of the month, the announcement was suddenly made that the Government had decided to suspend all work on the four huge warships for which the orders had just been placed. That step was the obvious and natural sequel to Mr. Balfour's avowal at the Washington Conference on Disarmament that Great Britain would support Mr. Hughes' scheme for a ten years' holiday from naval shipbuilding. But obviously logical as it was, obviously desirable as an exhibition of good faith and sincerity, it came as a shock to the country, and particularly to the North. The four ships would have cost thirty million pounds, and of that sum sixty or seventy per cent. would have gone direct to the pockets of labour. But more important still, the prosecution of the work would have had an imme-

diate effect upon industries. Even before [the year was out it would have led to the employment of four or five thousand men, and would have relieved many firms from the anxiety under which they have laboured for months. There can be no doubt that the placing of the orders had been anxiously awaited, was heartily welcomed, and was regarded as likely to mark the turning point in the wave of depression. In these circumstances, heartily as the nation may desire to show its zeal for the reduction of armaments, it may reasonably be asked if it would not have been wiser to continue at a slow pace the work on the four ships until the final decisions of the Conference had been reached. They would have given a good deal of employment, have brought happiness at Christmas to many homes, and would have cost the country little more than it must now expend in out of work benefits. The taxpayers will be no better off by the reduction for twelve months to come, and conceivably not then, unless the general improvement of trade is so great that a sum equivalent to the thirty millions is circulated by expenditure on peace products.

Hydro-electric Distribution.

THE putting in hand of hydro-electric undertakings in France has presented many problems owing to the necessity of distributing energy over large areas under much higher potentials than were originally proposed. In view of the difficulties encountered in the preparing of these projects, the Union of French Electrical Engineering Societies organised an international conference in Paris last week, at which seventeen countries were represented by forty delegates. As the same problems are met with everywhere, it was hoped that an exchange of ideas amongst engineers from all countries interested in hydro-electric distribution would be profitable to all concerned, and it appears that the outcome of the conference will be to favour still higher potentials as the best means of economically distributing energy at considerable distances from the power stations. The problem particularly interests the railway companies, which will be dependent upon hydraulic supplies for the electrification of the systems in the centre and south of France. So far, an entire dependence upon hydraulic power has not been satisfactory in view of the year's exceptional drought, which has so reduced the head of water in the Isère that it has been found necessary to ration consumers, and they are now only supplied with current three days a week. In the Grenoble district the situation is particularly serious, on account of the number of factories that have had partly to close down. This trouble is to be obviated in the future by utilising other hydraulic supplies as a reserve, and it has shown that ample provision must always be made against the disastrous results following upon the failure of any one source of supply. In the Dordogne arrangements are being made for putting down a vast installation for the distribution of energy to towns as far apart as Bordeaux, Limoges, Nantes and Clermont-Ferrand.

Fatal Railway Collision at Birmingham.

ON the afternoon of the 26th, whilst a local train for Derby was standing on No. 4 platform line at New-street Station, Birmingham, jointly owned by the London and North-Western and Midland Companies, it was run into by an express from Bristol. The two adjacent ends of the rear two coaches of the standing train were lifted into the air and crushed in. Two men and a baby were killed. The cause of the collision would, no doubt, be revealed at the inquiry Colonel Pringle was holding yesterday (Thursday). Obviously, the mishap was due either to the driver of the express entering the platform line without sufficient care, or to the signalman giving "clear" signals irregularly, and as the Midland Company admitted its liability at the coroner's inquest on Tuesday, we may assume that the fault lies with the driver. Some years ago the rule at this particular end of the station was that, owing to the steep falling gradient, the signalman was not to accept a train from Five Ways—the station next in the Bristol direction—unless the line was clear up to the stop signals on the footbridge in the station. Whether or not this rule is still in force we cannot say. If it is, it is important to note that the rear of the standing train was, we believe, outside the stop signals in question. This is the third accident this year in which passengers have been killed; the two previous were Abermule, January 26th, fourteen passengers killed; and Coatdyke, March 19th, one killed.

New Electric Power Station at Runcorn.

IN 1911 the Salt Union, Limited, erected a triple-effect vacuum plant at Weston Point, Runcorn—see THE ENGINEER, October 27th, 1911—for the economic production of salt from brine obtained from the Mid-Cheshire salt district by means of a pipe line between Northwich and Runcorn. In this process exhaust steam from turbines driving electric generators is utilised for evaporating brine in the vacuum plant. A portion of the energy so produced is used on the salt works, but the bulk is available for other purposes, and to facilitate the disposal of this surplus energy, the Salt Union obtained parliamentary powers authorising it to give a public supply of electricity for power and lighting. In the same year—1911—a subsidiary company, called the Mersey Power Company, Limited, was formed, to deal with the public electricity supply, and the Provisional Orders were transferred to that company.

AREA OF SUPPLY.

The area of supply includes the urban and rural districts of Runcorn and the borough of Widnes, but the Mersey Power Company subsequently obtained further powers by Fringe Orders permitting it to give considerable supplies of current to individual consumers at Ellesmere Port and elsewhere outside its original area of supply, and the company at the present time is seeking powers to extend the area to include Ellesmere Port. The Mersey Power Company's area is within the Mersey and West Lancashire Electricity District prescribed by the Electricity Commissioners, and is expected ultimately to include the whole of the area on the south side of the river Mersey within that district between Warrington and the Wirral, together with Widnes on the north side. After an inquiry held by the Electricity Commissioners at Liverpool in January and March of this year, as to the reorganisation of electricity supply in the Mersey and West Lancashire district, the Commissioners decided that the Mersey Power Company should continue to enjoy complete autonomy within its area of supply, that it might be empowered to extend its operations by bulk supply or otherwise, and that the fullest use should be made of its generating plant.

In 1911 the Mersey Power Company laid a system of transmission and distributing mains in Runcorn and Widnes, purchasing the current in bulk from the Salt Union, Limited, at the bus-bars of the generating station of the latter at Weston Point. The public supply was commenced on January 1st, 1912, and proved successful from the start. One and a-half million units were sold in 1912 and twenty-five million units in 1920. Additional generating plant was put down by the Salt Union, Limited, from time to time to meet the growing needs of the electricity users, until ultimately generating plant of 8250 k.w. capacity available for public supply was installed at the Salt Union's station. In 1918 the demand for current exceeded the point at which it could be economically produced in conjunction with the salt-making plant, and the Mersey Power Company decided to construct a large generating station at Percival-lane, Runcorn, adjoining the Bridgewater Canal and the Manchester Ship Canal on a site affording good foundations and comprising 27 acres. Excellent railway and water facilities are available, and the station—which has been designed by Messrs. Merz and McLellan, consulting engineers to the company—is now completed and was formally opened on the 25th ult. The site is laid out with a view to an ultimate output of 100,000 kilowatts, and the first installation comprises two 12,500-kilowatt Parsons turbo-generators supplied with steam from Babcock and Wilcox marine type water-tube boilers. Current will still be purchased from the Salt Union to the extent of its economical output, the remainder being generated at Percival-lane.

The supply is on the three-phase alternating-current system at 440 volts for power and on the single-phase alternating-current system at 250 volts for lighting, the long-distance transmission being carried out at 33,000 volts and short distance at 6000 volts and 3000 volts. The company has twenty-seven sub-stations situated at various points in the area of supply. A series of photographic illustrations of the new station are given herewith and on page 596, while on pages 585 and 586 are given plans of the complete lay-out and detaild rawings.

THE NEW STATION.

The work of excavation and laying the foundations for the buildings was carried out by Walter Jones and Sons, Limited, of London. The whole of the concrete for the stanchion bases was of reinforced construction. The steel chimney, which is 100ft. in height, stands upon a reinforced concrete base about 20ft. above the ground level. At the same time that the foundations were being put in the whole of the necessary cable pipes and ducts were laid from the various points in the engine-room to the switch-house to allow of the cables being drawn in afterwards. The engine-room floor is finished with Ironite.

The sidings into the works consist of about two miles of track and are fed from the Manchester Ship Canal Company's docks. There is also still under construction a siding having communication with the London and North-Western Railway. The first portion of the sidings was constructed by Jones and Sons, Limited, to the order of Messrs. Merz and McLellan. A plan showing the general lay-out of the station and sidings is given in Fig. 2, and two external views on page 596.

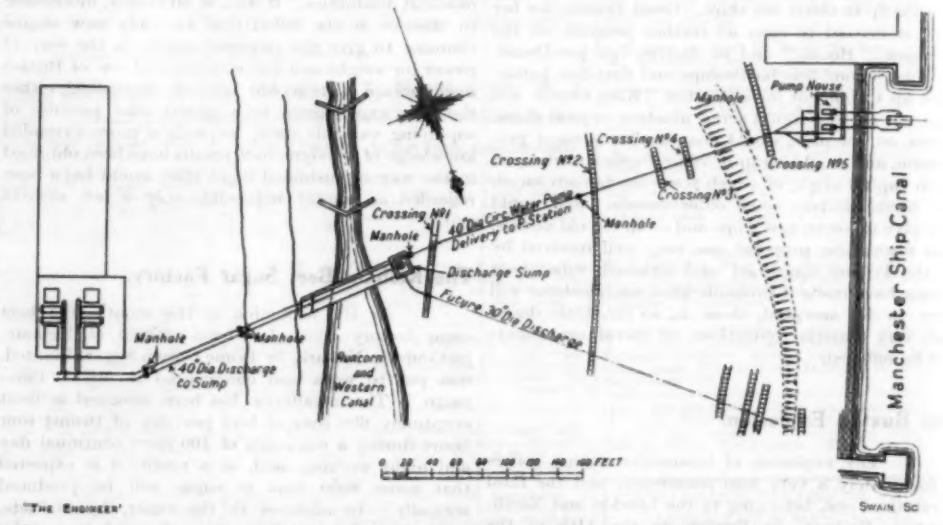

FIG. 1—DIAGRAM SHOWING CIRCULATING WATER ARRANGEMENTS

BUILDING.

The construction of the building itself was carried out by Heenan and Froude, Limited, of Manchester. The building, sectional views of which are given on page 586, consists of a steel-framed structure clothed with corrugated asbestos sheets, with the exception of the temporary side, which is covered with corrugated steel. The building is well supplied with roof and side lights, the glazing being of the wire-woven type. The length of the engine-house is 71ft. between the centre of the columns and its width is 62ft. The dimensions of the boiler-house are length 155ft. and width 56ft. There is a brick wall built round the building for a height of 3ft. from the basement floor level. The boiler-house firing floor is finished in concrete and blue Staffordshire bricks, and there is a large well opening at one end to allow of materials being hoisted up from the basement. The boiler-house contains a large steel coal bunker—see page 586—of the suspension type, capable of holding 800 tons of coal. From this the coal is supplied through three cast iron mouthpieces to each boiler, these mouthpieces containing a special regulating valve. The bunkers are lined throughout with bricks and there is a steel cross joist enveloped in concrete. The bunker side plating is extended for some 10ft. above the bunker sides in black corrugated iron to the roof in order to form a dust screen. The total weight of steel in the construction of this building alone is approximately 770 tons, and the whole structure has been so arranged that an additional bay can be easily added both to the engine-room and to the boiler-house.

STEAM GENERATING PLANT.

The boilers, pipe work, coal-handling plant, chimney and flues were supplied by Babcock and Wilcox, Limited, of London. There are three water-tube boilers, each capable of evaporating continuously 45,000 lb. of water per hour at a steam pressure of

NEW ELECTRIC GENERATING STATION AT RUNCORN

MESSRS. MERZ AND McLELLAN, LONDON, ENGINEERS

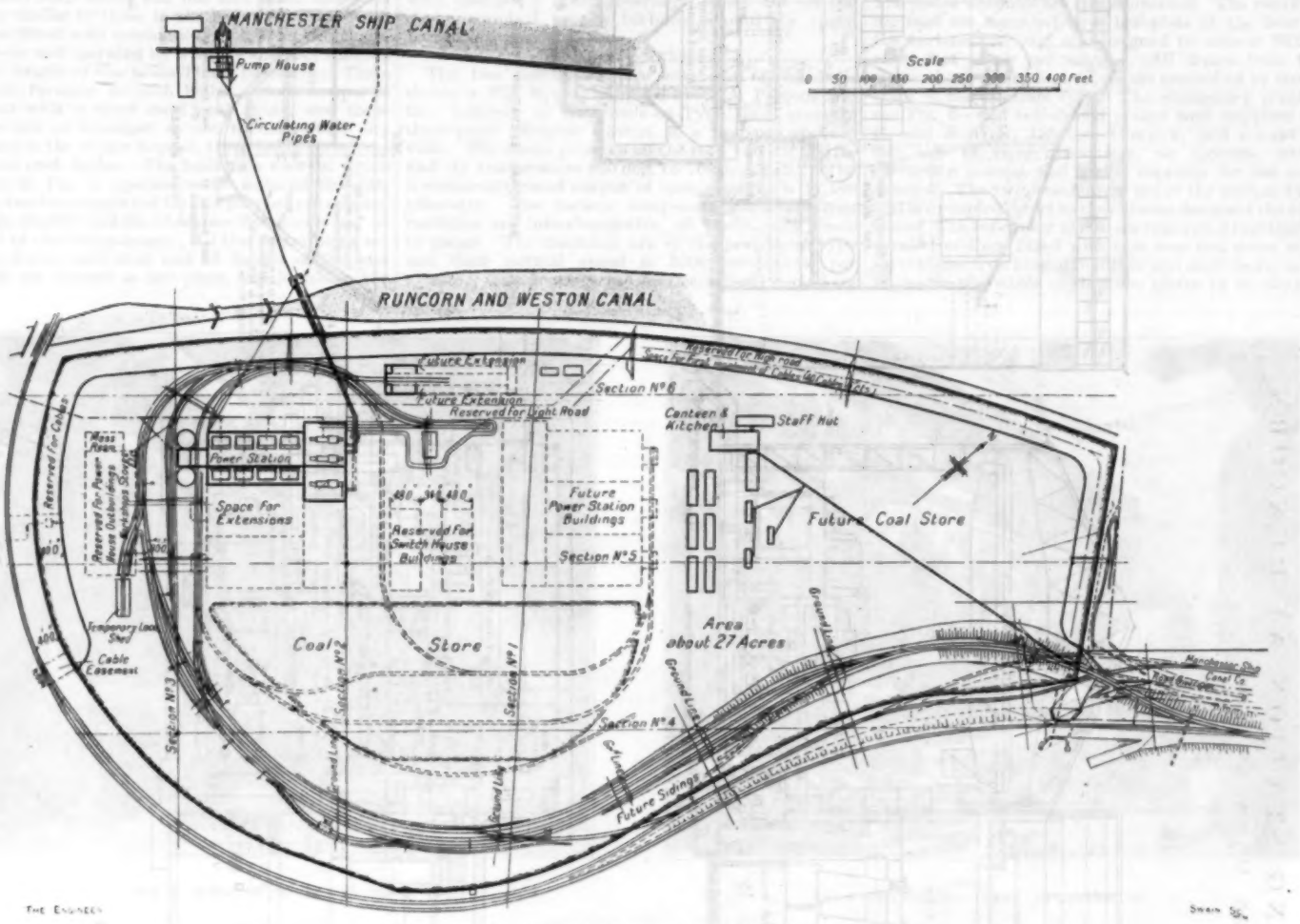

FIG. 2—GENERAL PLAN OF THE STATION

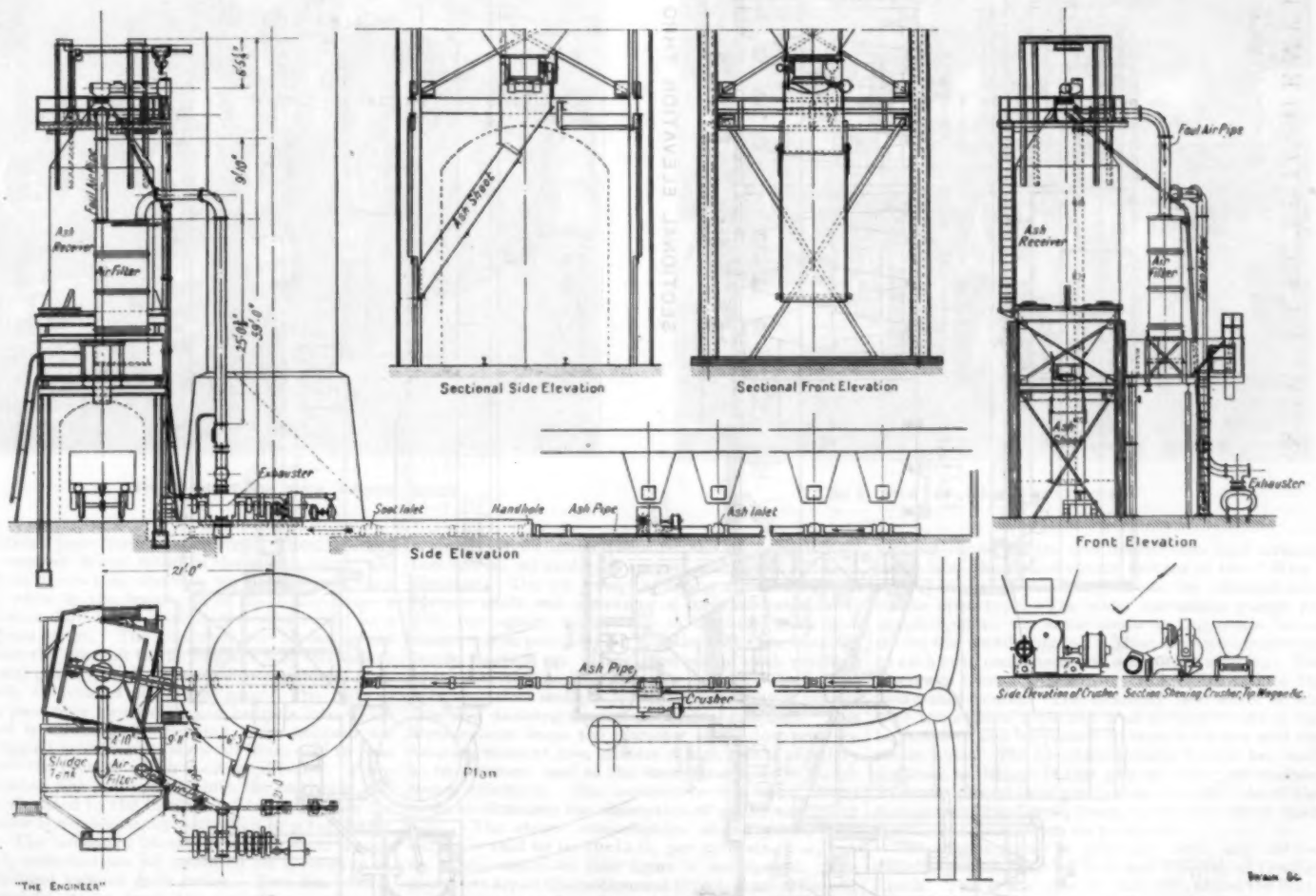

FIG. 3—ARRANGEMENT OF THE ASH-HANDLING PLANT

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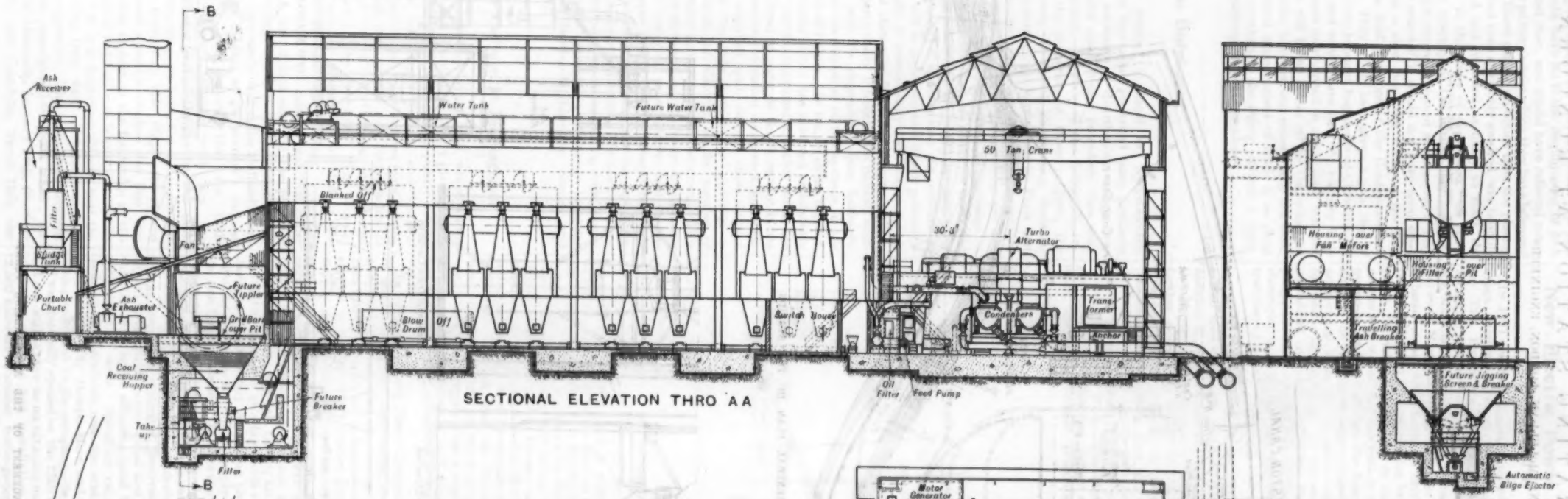


FIG

270 lb. per square inch and superheated to between 675 deg. and 700 deg. Fah. The economisers are carried on the top of the boilers and practically form a part of the boiler unit itself. Each economiser consists of a group of solid-drawn tubes heavily galvanised both inside and out and fitted into steel headers similar to those in the boiler section. Each boiler is fitted with mechanical stokers of the chain-grate type and operated by a line of shafting running the full length of the boiler-house basement. There are three furnaces to each boiler. Each hopper is provided with a sheet steel coal chute, and these hoppers are so arranged as not to necessitate any trimming in the stoker hopper, there being three coal chutes to each boiler. The boilers, a view of which is given in Fig. 5, operate under induced draught, and the two fans employed for this purpose are coupled direct to electric motors which are fitted in a bay at the end of the boiler-house. All the steam pipes are of solid-drawn mild steel and all flanges of 7in. and upwards are riveted to the pipes, the joints on the main steam pipe being also riveted. There are two steam receiver drums fitted in the engine-room, and it is from them that the two turbines obtain their steam, while in the basement of the boiler-house a large Lancashire boiler shell is provided to act as a blow-down drum. The conveyor for elevating the coal from the filler pit to the bunkers is of the endless chain and gravity bucket type and is capable of dealing with 40 tons of slack per hour. The railway sidings pass over two steel plate hoppers into which the coal is discharged; beneath these hoppers are fitted jigging grids, which allow all lump coal to pass over into the crusher which is situated below. From the crusher the coal passes into the conveyor and is then elevated to the bunkers. The feed water for each boiler is automatically controlled by a regulating valve. The necessary steam gauge, draught gauge and CO_2 recorders are all mounted on a column on the left-hand side of each boiler. Two 6in. steam pipes supply steam from the superheater of each boiler to the main.

There are three boiler feed pumps of the "Weir" rotary turbine-driven type, each pump being designed to deliver 175,000 lb. of water per hour. The speed of these pumps is governed by water on the delivery side of the pump. These pumps are also furnished with emergency shaft governors, which cut off the steam supplied to the turbines should the speed become excessive.

TURBO-ALTERNATORS.

The two turbo-alternator sets, one of which is shown in Fig. 9, were supplied by C. A. Parsons and Co., Limited, of Newcastle-on-Tyne, and generate three-phase 50-cycle current at a pressure of 6450 volts. The steam pressure on the stop valve is 250 lb. and its temperature 650 deg. to 700 deg. Fah. The continuously rated output of each machine is 12,500 kilowatts. The various component parts of these machines are interchangeable, all parts being made to gauge. The machines are of the horizontal type and their normal speed is 3000 revolutions per minute. The bearings are lubricated and cooled by a supply of oil under pressure, the oil being forced through an oil cooler of special design and through strainers. The oil pump is driven direct from the turbine shaft and maintains a constant pressure of 5 lb. per square inch, while in addition there is a steam-driven pump which supplies oil to the bearings before starting up. The steam end of each machine consists of high and low-pressure casings. The former is of cast steel and the low-pressure casing is double flow and discharges into two Weir condensers. This arrangement keeps the diameter of the low-pressure rotating element low, enables a high factor of safety to be retained, and at the same time secures a high steam efficiency. The condensate system is closed so as to eliminate the absorption of air by the boiler feed. The steam consumption at an economical output is said to be 10.15 lb. per kilowatt-hour, but an improvement on that figure is anticipated. The governors are of the mechanical type and are arranged so that they can be adjusted either by hand on the turbine or by electrical control from the switch-house. There is also a mechanical safety governor, so that should the speed rise to 3300 revolutions per minute the steam will be cut off. The alternators are of the rotary field type, have direct-driven exciters, and are ventilated by means of separately driven fans. The stator windings are star connected. The ventilating fans are mounted on a bed-plate at the base of the turbine pier and are designed to deliver 50,000 cubic feet of air per minute. All drains from the steam chest, piping and valves are controlled by steam traps of the Sentinel type. The condensing plant—see Fig. 6—and boiler feed pumps were supplied by G. and J. Weir, Limited, Glasgow, and consist of two sets of twin condensers, air ejectors, water extraction pumps, and spring supports for the condensers. The twin condensers are of the surface type and are coupled direct to the exhaust flanges of the turbines. The condenser shells are connected together in parallel and are fitted with cast iron end doors with several cast iron hinged manhole and mud doors, so as to enable the whole of the tube plates to be cleaned without removing the end doors. The feed arrangement is of the closed circuit system of the "Weir" type; but when necessary it can be changed over to the open type. The water extraction pumps are coupled on to the same shaft as the motor which drives the ventilating fan. There are two air ejectors to each twin condenser, one acting as a standby. The discharge from the steam ejectors is taken into the feed-water heater. The auxiliary feed-water heater is of the surface type and is so arranged that it can be isolated and by-passed on both the water and the steam sides. The circulating water pumps are each designed to deliver 14,000 gals. of water per minute. They are placed in a pump-house at the side of the Manchester Ship Canal, from which they draw their water—see illustration on page 584.

The engine-room is provided with one 50-ton travelling crane built by Holt and Willetts, of Cradley Heath. This crane runs on rails 50ft. above the basement level and travels the full length of the room. It is electrically driven, being supplied with current

FIG. 5—INTERIOR OF BOILER ROOM

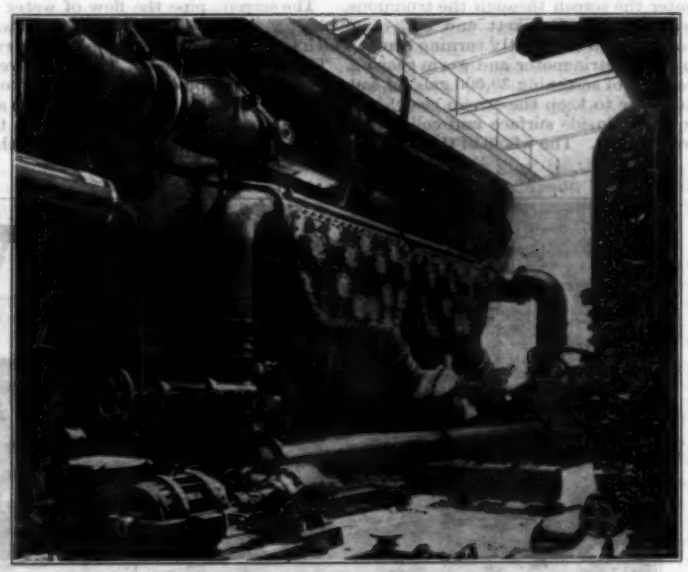


FIG. 6—CONDENSING PLANT IN BASEMENT

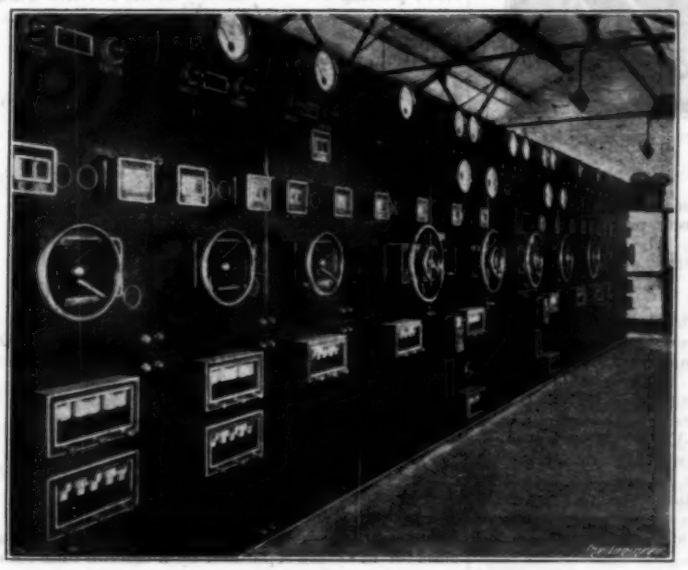


FIG. 7—FRONT OF MAIN SWITCH BOARD

FIG 8—BACK OF MAIN SWITCH BOARD

by side conductors. It has one 45, one 35, and one 10 horse-power motor and is capable of travelling up to a speed of 100ft. per minute. It is fitted with an electro-mechanical brake, which is released by a powerful solenoid that comes into action immediately the current is switched on to the lifting motor, and is re-applied immediately the current is switched off or should the current fail for any cause.

Pump-house.

The pump-house is situated on the bank of the Manchester Ship Canal, from which the circulating water is drawn and from which a pipe is laid crossing the Runcorn and Weston Canal by a 40ft. span bridge direct on to the power-house, a distance of some 120ft., the water being returned to the Runcorn and Weston Canal. The pump-house contains two 350 horse-power motors and pumps, the pumps being built by Weirs, Limited, and the motors by J. H. Holmes and Co., Newcastle-on-Tyne. From the pump-house the pipe line continues on a short jetty some 40ft. in length to a rotary screen which removes all floating *débris* from the water. The suction pipes enter the screen through the trunnions. The screen was built by Brackett and Co., of Colchester, and consists of a constantly turning drum, which is driven by an electric motor and worm gearing. The drum is capable of screening 30,000 gals. of water per minute. In order to keep the screen clear, jets of water play upon its inside surface and collect all *débris* into an iron trough. The whole of the screening arrangement

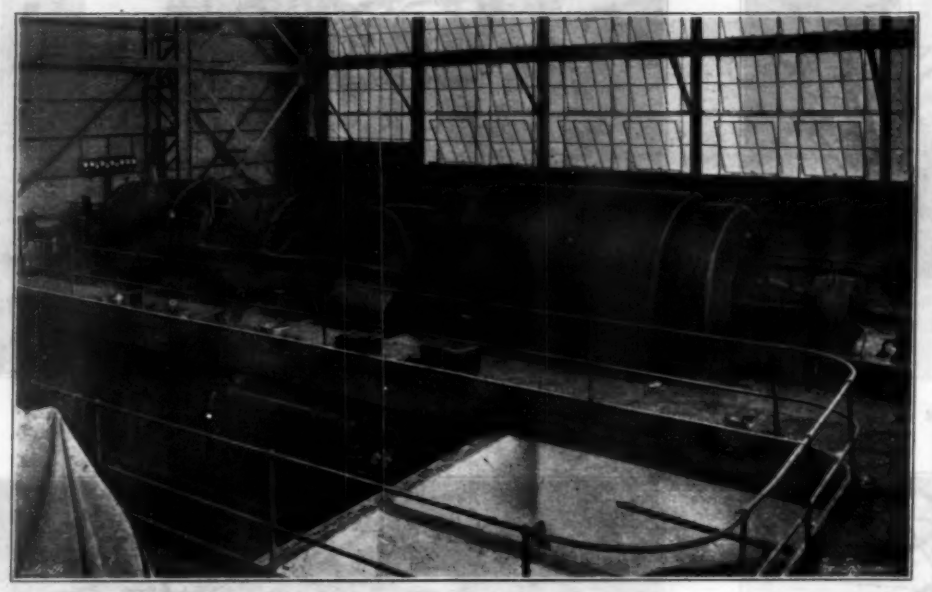


FIG. 9—12,500 KILOWATT PARSONS TURBO-ALTERNATOR

has been designed to obviate the use of under-water cement work or piling.

The Ash Plant.

The ash plant, shown in Fig. 3 on page 585, was supplied by Bennis and Co., and is of the suction type. The red-hot ashes, as they are withdrawn from the ash hoppers beneath the stokers, are passed direct through a breaker into a pipe, and carried by suction pressure to an ash receiver tank outside the boiler-house. The plant is designed to remove the ashes from twelve chain-grate stokers and is operated in the following manner:—As the ashes fall over the end of the chain grate they drop into small ash hoppers built underneath the back of the chain grates, from which they are periodically removed by opening a valve. The ashes as produced are irregular in size, many pieces being larger than the diameter of the ash pipes, and it is necessary to break these larger pieces to a size suitable for the ash pipes. A portable electrically operated ash breaker is provided for the purpose. This breaker is pushed by hand along a light tramway track to the hopper being emptied, and as the ashes flow from the hopper they pass into the breaker. An ash inlet opening is placed on the ash pipe under each ash hopper. The cover is removed from the opening and the broken ashes flow direct from the breaker into the ash pipe, along which they are carried by suction to the ash receiver tank placed outside the end of the boiler-house.

After depositing the ashes, the current of air is passed along the foul air pipe to the exhauster, but a considerable quantity of fine ash dust is held in suspension in the air, and if it were allowed to pass through the exhauster the abrasive nature of the dust would cause rapid wear and tear of the internal fittings. To prevent this, the foul air is passed through a filter, which extracts the dust and deposits it in a sludge tank, from which it is periodically removed. After being filtered it then passes forward to the exhauster and thence through the exhaust pipes into the chimney.

The ash receiver tank is placed overhead at a sufficient height to allow railway trucks to pass beneath, so that the ashes can be dumped direct from the receiver into the trucks. A special shoot is provided to deliver the ashes on to the ground or into barrows or small trucks if it became necessary to do so. The cleaner and sludge tank are carried on an extension to the structure which supports the ash receiver, and both are also placed at such a height as to allow of the sludge being raked out and dumped direct into railway trucks. The exhauster is of the "Roots blower" type and is driven through machine-cut spur gearing by a 100 brake horse-power electric motor. A water service is provided at the inlet to the ash receiver to quench the ashes, and there is another water service at the top of the air filter. The water is supplied to these parts through a system of water pipes from an electrically driven centrifugal pump placed adjacent to the exhauster.

The amount of water passing along the pipes is automatically controlled by a valve placed on the main water pipe. This valve is connected to the air pipes and operates in such a manner that when no ashes are being carried along the pipes the water supply is checked, while when ashes are passing along the pipe the flow of water increases. The object of this valve is to prevent waste of water caused by the sprays continuing to run whilst the ashes are being passed. A relief valve is provided on the clean air pipe at the entrance to the exhauster. This valve is automatic in its action and allows the air to pass direct into the exhauster in the event of chokage or other emergency arising in the ash pipe. A hand-operated cat head crane is provided over the top of the receiver to facilitate the renewal of any parts that may be required in the course of time. The plant throughout is designed in such a manner that easy access can be obtained to all parts of it.

Transformers.

The two long feeders to Ellesmere Port are supplied from an outdoor step-up transformer station, where the pressure is raised from 6500 to 33,000 volts. There are two banks of six transformers of 1667 k.V.A. capacity each. The transformers are oil cooled and were supplied by the Metropolitan-Vickers Electrical Company. The oil is cooled by two small rotary pumps driving the circulating water round the oil coolers. The water can either be supplied from the town main or from the circulating main from the Ship Canal. These pumps are placed in brick buildings at the end of each bank of transformers.

Switchboard.

The main switchboard is placed in a building that is entirely separate from the power-house and about 100ft. from the main engine-room. It is a plain brick building, 47ft. by 20ft., covered with a corrugated asbestos roof. The main switchboard controls the two turbo-alternators, the out-of-door step-up sub-station for the district supply to Ellesmere Port, and the various feeders. The switchboard is of Reyrolle's special design and is operated by hand. All the panels are fitted with Merz-Price gear, while the feeders are furnished with the Merz-Price overload and balanced protection system. The whole of the switchgear is ironclad, each switch being immersed in a steel tank which is filled with oil. The whole of the auxiliaries are controlled through two additional switchboards also supplied by Reyrolles, one being situated on the turbine platform and the other in the boiler-house basement.

Station Lighting.

The station lighting was carried out by the Mersey Power Company and the station is wired throughout for 110 volts. The circuits can either be supplied with current from the station transformer or can be connected to the battery. The latter, which was supplied by the Tudor Accumulator Company, consists of sixty-three cells having a normal discharge rate of 80 ampères with a maximum of 120 ampères and is charged from a motor generator set placed on the engine-room floor above the battery room. The distribution switchboard for the 110-volt direct current and the battery was supplied by J. H. Holmes and Co., of Newcastle-on-Tyne. It consists of a six-panel enamelled black slate board, mounted on which are the switchgear for charging and discharging the battery and for operating the motor generator.

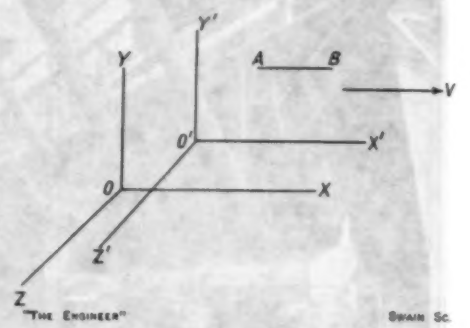
Einstein and the Theory of Relativity.

By Major H. J. JONES, O.B.E., R.A.O.C., A.M.I. Mech. E., A.R.C.S. &c.

No. III.*

Apparent Contraction.

Let the two origins, O and O′, with their rectangular axes of reference be as represented in the accompanying diagram, O′ having a uniform rectilinear



velocity V relatively to O. Let A and B be two particles whose co-ordinates are:—

(1) Reference to O, $x_1\ y_1\ z_1\ t_1$
$x_2\ y_2\ z_2\ t_2$.

(2) Reference to O′, $x_1'\ y_1'\ z_1'\ t_1'$
$x_2'\ y_2'\ z_2'\ t_2'$.

Now, putting $\beta = \dfrac{1}{\sqrt{1 - \dfrac{V^2}{c^2}}}$ in the Lorentz transformation, we have—

$$x_1' = \beta (x_1 - V t_1),\ y_1' = y_1,\ z_1' = z_1,\ t_1' = \beta \left(t_1 - \frac{V}{c^2} x_1\right),$$

and

$$x_2' = \beta (x_2 - V t_2),\ y_2' = y_2,\ z_2' = z_2,\ t_2' = \beta \left(t_2 - \frac{V}{c_2} x_2\right),$$

Hence

$$(x_2' - x_1') = \beta \{(x_2 - x_1) - V (t_2 - t_1)\},$$

and

$$(t_2' - t_1') = \beta \left\{(t_2 - t_1) - \frac{V}{c^2} (x_2 - x_1)\right\}.$$

Now, if the two particles are at rest relatively to O′, we may write $(t_2' - t_1') = 0$.

Hence

$$\beta \left\{(t_2 - t_1) - \frac{V}{c^2} (x_2 - x_1)\right\} = 0,$$

or

$$(t_2 - t_1) = \frac{V}{c^2} (x_2 - x_1).$$

That is to say, events that are simultaneous to an observer in O′ are separated by a definite interval of time $\dfrac{V}{c^2} (x_2 - x_1)$ for an observer in O.

Again, the x component distance between the two points as measured from O′ is $(x_2' - x_1')$ and from O $(x_2 - x_1)$.

And since

$$(x_2' - x_1') = \beta \{(x_2 - x_1) - V (t_2 - t_1)\},$$

we have

$$(x_2 - x_1) - V (t_2 - t_1) = \frac{1}{\beta} (x_2' - x_1'),$$

and as

$$(t_2 - t_1) = \frac{V}{c^2} (x_2 - x_1),$$

we have

$$(x_2 - x_1) - \frac{V^2}{c^2} (x_2 - x_1) = \frac{1}{\beta} (x_2' - x_1'),$$

or

$$(x_2 - x_1) \left(1 - \frac{V^2}{c^2}\right) = \frac{1}{\beta} (x_2' - x_1'),$$

* No. II. appeared November 25th.

and since

$$\beta = \frac{1}{\sqrt{1 - \frac{V^2}{c^2}}}.$$

$$x_2 - x_1 = \frac{1}{\sqrt{1 - \frac{V^2}{c^2}}}(x_2^1 - x_1^1).$$

That is to say, the x component distance between A and B, as measured from O is shorter than the same distance as measured from O′; in other words, the distance *appears* to have contracted.

Similarly as regards time. Imagine A and B to represent two events, light flashes, separated by an interval $(t_2^1 - t_1^1)$ as measured from O′, and $(t_2 - t_1)$ as measured from O.

Then since

$$(t_2^1 - t_1^1) = \beta\left\{(t_2 - t_1) - \frac{V}{c^2}(x_2 - x_1)\right\},$$

and since the velocity of O′ relatively to O is V, or $\frac{x_2 - x_1}{t_2 - t_1}$, we have by substitution—

$$(t_2^1 - t_1^1) = \beta\left\{(t_2 - t_1) - \frac{V^2}{c^2}(t_2 - t_1)\right\},$$

or

$$(t_2 - t_1) = \frac{1}{\sqrt{1 - \frac{V^2}{c^2}}}(t_2^1 - t_1^1).$$

In other words, the time interval as measured from O is longer than the same time interval as measured from O′. Thus, if we imagine observers in systems O and O′, who judge time by clocks based on some common natural standard, then the same event appears to take longer to O than to O′.

Composition of Velocities.

It is a common occurrence in dynamics to have systems O, O′, O″, &c., in which the relative velocities of O′ to O and of O″ to O′ are known, and it is required to find the relative velocity of O″ to O. According to Newtonian dynamics, if V_1 be the velocity of O′ relatively to O, and V_2 that of O″ relatively to O′, then $(V_1 + V_2)$ is the velocity of O″ relatively to O. Relativity dynamics, however, gives the relative velocity as

$$\frac{V_1 + V_2}{1 + \frac{V_1 V_2}{c^2}}$$

for by the Lorentz Transformation

$$x^1 = \beta_1(x - V_1 t) \text{ and } t^1 = \beta_1\left(t - \frac{V_1}{c^2}x\right);$$

also

$$x'' = \beta_2(x^1 - V_2 t^1) \text{ and } t'' = \beta_2\left(t^1 - \frac{V_2}{c^2}x^1\right).$$

By substitution we get

$$x'' = \beta\left(x - \frac{V_1 + V_2}{1 + \frac{V_1 V_2}{c^2}}t\right), \text{ &c.,}$$

which is a Lorentz Transformation with a parameter

$$V = \frac{V_1 + V_2}{1 + \frac{V_1 V_2}{c^2}}.$$

The previous reference to the measured relative velocity of β particles, when each have a velocity $\frac{9}{10}c$ relatively to the earth is now clear. For putting $V_1 = V_2 = \frac{9}{10}c$ we get $V = \frac{1.8\,c}{1.81\,c}$, which is less than C.

Generally, if V_1 and V_2 be less than C we may write $V_1 = c - a$ and $V_2 = c - b$, so that

$$V = \frac{(2c - a - b)}{2c^2 - c(a + b) + ab} = \frac{2c - a - b}{2c - (a + b) + \frac{ab}{c}}c$$

or

$$V < c.$$

So that the measured resultant of any velocities less than that of light is also less than that of light. If $V_1 = c$ it is clear that the resultant is equal to C.

Fresnel's Convection Coefficient.

The above theorem on the composition of velocities enables us to get a kinematic explanation of Fresnel's Convection Coefficient without making any artificial assumptions as to the constitution of matter, or the effect of motion of matter on the æther. If we suppose a wave of light travels through a refractive medium with a relative velocity c/μ, where μ is the refractive index, then if the medium be given a velocity V_1 in the direction of the propagation of light, the observed velocity V will be compounded of V_1 and c/μ in accordance with the above velocity addition formula.

Thus

$$V = \frac{c/\mu + V_1}{1 + c/\mu\,\frac{V_1}{c}} = \frac{c}{\mu} + V_1\left(1 - \frac{1}{\mu^2}\right) + \text{&c.}$$

which gives the well-known convection coefficient $\left(1 - \frac{1}{\mu^2}\right)$ as suggested by Fresnel and verified by Fizeau.

The Interval Between Two Events.

In view of the complete relativity of the motion of a particle and the time of an event, the question now arises whether it is possible to express quantitatively the intrinsic character of the changes in space and time which localise any two events. For example, if we look upon an event as a physical reality and its repetition as another reality, the question arises whether it is possible to frame an expression which will be a quantitative description of the changes in space and time involved between the two events, and as physically real as the events themselves; an expression which will give a metrical property of the physical world independent of the circumstances of any particular observer.

It is clear from the previous discussion that the localisation of these events by the co-ordinates $(x, y, z)\,t$ will include terms expressing the character of the relative motion of each observer; but it is not clear, without further inquiry, whether we can isolate the intrinsic part of the localisation from the relative part. Einstein in his Restricted as well as in his General Theory of Relativity postulates that it is possible to find such a measurable quantity—the analogue of distance in Newtonian dynamics—which is the same for all observers, no matter what motion they may have. This quantity is called "the interval." It is defined by the expression—

$$d\,s^2 = d\,t^2 - d\,x^2 - d\,y^2 - d\,z^2,$$

and is, of course, invariant with respect to the Lorentz Transformation. Recent research, however, has thrown some doubt on the possibility of defining such a quantity uniquely. It appears probable that it is a quantity proportional to $d\,s$ and not $d\,s$ alone that can be so expressed, so that the interval loses its assumed absolute character and relapses into the general relativity of all knowledge.

Mass and Momentum.

In Newtonian dynamics in which material bodies are assumed to have a constant characteristic called mass, the formula for momentum is written $m\frac{d\,x}{d\,t}$. In Relativity dynamics the time $d\,t$ is replaced by the interval $d\,s$, and momentum is written $m\frac{d\,x}{d\,s}$.

Now

$$m\frac{d\,x}{d\,s} = m\frac{d\,t}{d\,s}\cdot\frac{d\,x}{d\,t}.$$

Hence we may consider the new momentum as compounded of two factors, one $\frac{d\,x}{d\,t}$ the velocity and the other $m\frac{d\,t}{d\,s}$, which is no longer invariant, but depends on the motion relatively to the observer.

Now,

$$d\,s^2 = d\,t^2 - d\,x^2 - d\,y^2 - d\,z^2,$$

$$\therefore \left(\frac{d\,s}{d\,t}\right)^2 = 1 - \left\{\left(\frac{d\,x}{d\,t}\right)^2 + \left(\frac{d\,y}{d\,t}\right)^2 + \left(\frac{d\,z}{d\,t}\right)^2\right\} = 1 - u^2.$$

where u is the resultant velocity.

If we write $M = m\frac{d\,t}{d\,s}$, we have

$$M = \frac{m}{\sqrt{1 - u^2}} = m + \tfrac{1}{2}m\,u^2 + \text{ . . . &c.}$$

in which we may look upon M as the rest mass and $\frac{1}{2}m\,u^2 +$ . . . the energy of motion. Now, from electro-dynamical considerations, the electrical mass is the energy of the static field, and by analogy we may consider M, the rest mass, to be merely energy, and identified with it. This supposition opens up the suggestion that what we have called mass, in the Newtonian sense, is merely untapped or latent energy, and that what we call energy is but a minute part of the total energy that is available in the universe.

Mass and Energy.

One of the fundamental principles of Newtonian dynamics is that the acceleration of a moving particle is in the same direction as the resultant of all the forces acting on it, and is equal in value to this resultant divided by a constant "M," called the mass of the particle; or, in the usual nomenclature, $P = M\,f$.

Until the discovery of the phenomenon of radio-activity this principle seemed to be in the most complete unvarying concordance with the facts of experience; but in the light of the theory of relativity we find that this concordance is merely approximate and accidental, and arises from the circumstance that we have been accustomed to deal with velocities not comparable with that of light. In the case of β particles and the cathode rays, however, we are made acquainted with material particles moving with immense velocities approaching nine-tenths that of light; and it is clear that to account for the dynamical behaviour of these particles a radical modification of Newtonian conceptions is necessary.

We know that β particles are material nuclei charged with negative electricity, and that when in motion they exhibit the phenomenon of self-induction which acts like the inertia of a body in opposing all changes to motion. These β particles therefore possess, in effect, a double inertia—that due to their mere mass and that to the self-induction produced by their motion. In other words, they appear to have a real rest mass, and a fictitious mass of electro-dynamic origin. Theory shows that the force of inertia of self-induction arising out of a change in direction of motion is not the same as that arising out of a change in velocity. The total mass is therefore not the same when an accelerating force tends to alter the direction of motion as when it tends to alter the velocity. We thus arrive at a conception of longitudinal mass as contrasted with transversal mass. The experimental work of Kaufmann and the theoretical work of Abraham have made it possible for us to disintegrate the proportion that the actual mass bears to the total mass *as* defined above, with the most unexpected result that the actual mass appears to be nil, and the whole of the apparent inertia of the particle is fictitious and of electro-dynamic origin. In other words, the Newtonian conception of mass falls to the ground and the relation $P = M\,f$ ceases to be true. Bodies either have no real mass or else their mass is not constant, but varies with the velocity in exactly the same manner as the electro-dynamic mass varies.

Summary.

The foregoing discussion may be taken to be a brief *résumé* of the general standpoint of Relativity, and some of the more immediate implications of the Restricted Principle which Einstein enunciated in 1905.

We have seen that Einstein has called into question the adequacy of practically every concept of Newtonian dynamics. Such fundamental notions as the distance between two points, the time between two events, and the mass, momentum and energy of a particle have been relieved of their assumed absolute character, and given a purely relative aspect which is determined by the circumstances of the observer relatively to the object or event measured. The massacre has been so thorough and complete that in all probability the engineering text-books of a quarter of a century hence will not contain a reference to these familiar terms of classical dynamics.

In addition we have found that during the past two hundred years a whole series of arbitrary hypotheses has been introduced into physical theory to explain phenomena ranging from Bradley's aberration, the Doppler principle, the behaviour of refractive and dispersive media when in motion, the Michelson experiment, &c., to that associated with the radio-active properties of matter. These hypotheses have been introduced *ad hoc*, and in effect have assigned to gross matter, when in motion, certain real physical changes for which, however, no direct confirmatory evidence has ever been obtained. The revolution brought about by Einstein has enabled us to dethrone the whole of these hypotheses without electing any new ones to serve in their places. Einstein has shown that these hypotheses, invented to explain certain supposed physical facts, were really explaining the mere appearances that have been introduced into our measurements by the fortuitous circumstances of the observer's motion.

Sufficient has been said to enable an engineer to understand the new mode of dynamic thought which Einstein has established. Among the infinite number of systems of co-ordinates having uniform rectilinear motions relatively to each other, it is permissible to use any one for the description of physical phenomena. No one system takes precedence over any other system. All have equal validity. In other words, the form of the mathematical expression of physical laws made by observers having any sort of uniform rectilinear motion is independent of that motion. Einstein's Restricted Principle, in effect, reduces to the statement that the proof of any given form of expression of a physical law being a valid one, is that it must be invariant with respect to the Lorentz Transformation. But this position is obviously most unsatisfying, for it deals solely with uniform rectilinear motion and leaves untouched such important aspects of dynamics as are included within rotation and general accelerated motion. Einstein saw this difficulty, and it was in an effort to extend the principle of Relativity to include all types of motion, and to place the whole theory on a broader philosophic basis, that he evolved the masterly analysis which forms the subject of the 1915 General Principle of Relativity.

A NOTE on a recently suggested scheme for low temperature carbonisation of fuel appears in a "Weekly Coal Summary," recently issued by Mr. Phillip Geo. Organised opinion among the coalowners, the note states, is strongly in favour of the scientific utilisation of fuel, but it is felt that the matter has not yet advanced very far beyond the experimental stage. Claims have been put forward on behalf of various carbonisation processes, and they are being closely examined with a view to ascertaining their practicability, from an economic point of view. When it can be demonstrated beyond doubt that plant can be erected and operated on a sound commercial basis the owners will require no persuasion to give their support to such undertakings.

The Public Works Conference.

No. II.*

IN our last issue we discussed the proceedings at the first two-days meetings of the Public Works, Roads and Transport Conference at the Agricultural Hall. Further meetings were held on November 21st to 25th inclusive under the auspices of a number of institutions, but it is not necessary to refer in detail to all of them. For instance, on Monday, November 21st, there was a general discussion on the advisability of formulating in advance schemes of a definite character in connection with public works with a view to such schemes being undertaken expeditiously during cycles of trade depression. It cannot be said to have been a convincing debate, for obvious reasons. Indeed, it might well happen that schemes got out in this way, assuming public officials have time to get to work on them for use in the indefinite future, might be quite incapable of application on account of change of circumstances by the time they are wanted. In the afternoon of the same day, the subject for discussion was small holdings and their equipment.

The care and upkeep of road appliances, which was dealt with in a paper by Mr. H. T. Chapman, county surveyor for Kent, on Tuesday, November 22nd, contained a mass of sound advice, much of which at first sight might appear superfluous, though experience shows it to be far from being the case. Incidentally, the paper demonstrated in a striking manner the ramifications of road work nowadays and the variety of engineering appliances needed.

One of the more interesting papers was that by Mr. C. G. Henzell, the Leeds Corporation waterworks engineer, who dealt, on Thursday, November 24th, with the relation between water mains and reinforced concrete roads, which are now becoming rather common. Waterworks engineers are very perturbed at the possibility of extra expense in connection with breaking up reinforced concrete roads for the purpose of renewing and repairing their mains. It is a question which not only affects water mains, but gas mains and electric light mains. The common sense of it, of course, is that the highway engineer and the statutory authorities which have powers to break up the roads should work in greater harmony than is now too often the case, so that the repair of old or the laying of new mains of any description might be carried out at a time when the road itself is either being made up for the first time or being repaired. If that were done, a great deal of expense would be saved all round. In Leeds that appears to be the case, and it is also done in other places. However, instances are too frequent of roads being broken up by the statutory authorities almost immediately they have just been relaid. On the question of cost to the statutory authorities by reason of the substitution of reinforced concrete for ordinary concrete, it is pointed out that heavy concrete foundations for roads have been common practice for many years, but that the substitution of reinforced concrete enables the thickness of the concrete to be quite appreciably reduced, thus, if anything, bringing down the cost of opening the roads subsequently. That was about as far as the matter was carried.

The internal corrosion of water pipes has been a matter of discussion for a very long time now, and the paper by the city surveyor of Worcester, Mr. William Ransom, on November 24th, did not carry the problem much nearer a solution, except that it brought out in the discussion information that recent experiments with 60in. water mains in the direction of coating them, by a centrifugal process, with cement, seem to have brought a solution of the difficulty somewhat nearer. There are numbers of compounds on the market which claim to afford complete immunity from corrosion, but experience has not always confirmed all the claims made. Apart from actual coating, reference may be made to the fact that recently a new form of cast iron pipe, the Delavand spun pipe, has been introduced, in which the metal is cast by centrifugal action, and the resulting pipe is said to be uniform in thickness, solid in structure, of high tensile strength and free from blow and sand holes. It is claimed that the greater density of the material renders it less liable to corrosion than the ordinary sand-cast pipe. The whole problem has now been relegated to the executive of the British Waterworks Association to take such steps as it thinks fit towards helping in arriving at a solution of this difficulty, as was the subject of water fittings, which formed the centre of a discussion upon anti-waste. A standardisation committee of the Association has been at work on this matter, and it is hoped to introduce standard fittings very shortly.

With the present development of mechanical road traction, and particularly in view of the large number of steam wagons that are in service, the supply of water to such vehicles is a problem which needs attention. The vehicle owners desire facilities, and it rests with the water authorities of the country to provide them—of course, on terms. In several of the northern towns there are facilities in the shape of roadside standpipes or tanks, but it is most desirable to arrange some form of standardisation of the precise apparatus on the roadside and the connections which the drivers of vehicles may or may not have to carry, i.e., the actual connecting hose for getting the water into the wagon may be housed at the standpipe or it may have to be carried about on the vehicle. Here, again, the executive of the British Waterworks Association was asked to take the matter in hand, and a rather unconvincing resolution was passed affirming the necessity for uniformity throughout the country in the facilities offered. The discussion of the subject was introduced by Mr. J. R. Davidson, of Liverpool, where a large number of experiments have been carried out with various types of standpipe. Most of the difficulties seem to have arisen from the rough handling which the vehicle drivers give the apparatus, and the knavish tricks of the small boy.

The final day of the Conference, Friday, November 25th, was given up to the consideration of electric vehicles in municipal service, and the general use of electricity in public service.

In the first place, a paper was read by Mr. F. Ayton, the chairman of the Electric Vehicle Committee of Great Britain, once engineer and general manager of the Ipswich Corporation electricity and tramways undertaking, and now with Ransomes, Sims and Jefferies, of Ipswich, in charge of their electric vehicle department. There is little doubt from the paper, and from what is known otherwise, that the use of electric vehicles in municipal service is expanding by leaps and bounds. Particularly is that so for house refuse collection, where the short journeys and frequent stops make such vehicles far superior to horses and even better than those driven by petrol engines. Municipalities all over the country are now using electric vehicles for this and other purposes, and the chorus of satisfaction seems fairly complete so far as the financial aspect is concerned. There still remains much to be done, however, in the matters of charging facilities and arranging a suitable tariff, if the use of electric vehicles is to be extended very considerably to private users for purposes for which they are eminently suitable. For instance, people speak of electricity for this purpose at 1d. or 1½d. per unit, but it is often overlooked that that is not the final cost by any means, as the current is generally metered into the motor generator and the losses there have been found to increase the price per unit delivered into the battery up to as high as 3d. or 3½d. per unit. The provision of charging facilities is also another difficulty. Those few municipalities which have taken the bull by the horns and spent the money on a garage and the necessary facilities do not seem to have done so badly, because the electric vehicle is a good customer for the electricity department. Others, however, and they are the great majority, seem to be waiting for fleets of electric vehicles to appear on the streets before making any endeavour to provide charging facilities. Thus we find the development outside municipal service hung up because potential users say that when there are charging facilities they will go into the question of buying vehicles, whilst the supply authorities, in effect, ask that the vehicles should be bought before they will go into the question of providing means to charge them. Those who are most enthusiastic in the cause recognise this apathy on the part of the supply authorities as a serious handicap. During the discussion of the paper, only one speaker was found to say that for house refuse collection he could do the work better with petrol than steam, and that was Captain Cable, of Westminster, who has been carrying out an experiment under similar conditions, with a petrol and an electric van, for this purpose. It appears, however, that in Westminster the journeys do not involve the many short stops that are inevitable in most places, and, moreover, the Westminster City Council seems to have found a means of buying petrol at a low price, so that the comparison is not so fatal to the electric vehicle as it would appear at first sight.

Complaints were made of the high price of electric vehicles, *qua* capital cost, but Mr. Ayton, as a manufacturer, said he could not hold out any hope of reduction in the present condition of affairs. All the manufacturers, he said, were executing orders at bare cost or something less, but that when the demand for the vehicles increased, the price would come down. There apparently seems to be no hope of the manufacturers trying to create a demand by reducing prices as far as they can—on a profit-making basis, of course. This, however, is all bound up with the reduction of production costs, which every manufacturer has in mind only too keenly at the moment.

Mr. S. J. Watson's paper in the afternoon of Friday, 25th, on the application of electricity to municipal services was a collected series of statistics from which some interesting facts for the supply station engineer were extracted. One point to which some prominence was given was the comparatively large use of electricity in gasworks, and the fact that gas company officials are going to municipal electrical engineers for supply, rather than generate current for themselves by means of gas engines and their own gas.

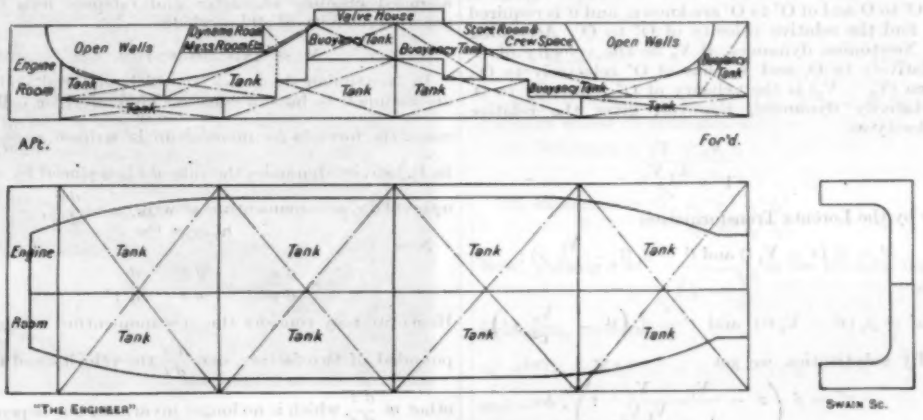
* No. I. appeared November 25th.

Institution of Mechanical Engineers, North-Western Branch.

THE MACHINERY OF FLOATING DOCKS.

IT was very unfortunate that the reading of Dr. Salmon's paper on "The Machinery of Floating Docks," before the North-Western Branch of the Institution of Mechanical Engineers, clashed with other important fixtures in Manchester. The attendance was very poor and the discussion that followed the author's synopsis of his paper fell far below the average standard. Mr. William Fox, the mechanical engineer to the Manchester Ship Canal Company, who was unable to be present, sent in a written contribution comprising a description of the two floating docks on that waterway, an abstract of which is appended:—

The smaller dock at Manchester is capable of lifting a vessel 300ft. in length and a weight of 2500 tons; the length of the dock is 260ft., with a depth of water over the blocks of 16ft. The larger pontoon stationed at Ellesmere Port is capable of lifting a vessel of 350ft. in length and a weight of 3000 tons, the length of the blocks being 300ft., the breadth of clear entrance 51ft., and the depth over the blocks 18ft. Scow ends are fitted at each end, and the total length on the blocks is 320ft. By fitting a temporary cofferdam a vessel of 4350 tons net weight can be lifted. This type of dock, whilst being of the usual box shape, is different from most other docks of the same type. It is designed according to a patent of the late Mr. Taylor, who was a director of the firm to which the dock belongs. The side walls of the dock are cut away without destroying the longitudinal strength, thus reducing top weight as well as admitting more light to any work inside the pontoon and facilitating the drying of paint, &c. The cut-away of the side walls also provides a more ready means of access to the dock bottom, on to which material can be taken practically straight. Additional advantage is gained in the rapidity with which the dock can be sunk, owing to less weight of water being required to overcome buoyancy.



FLOATING DOCK ON MANCHESTER SHIP CANAL

The pumping machinery is composed of two steam-driven centrifugal pumps, one port and one starboard, situated in the bottom at the after end. These pumps are 24in. diameter and, running at 120 revolutions per minute, are capable of lifting a ship of 3000 tons weight in two hours. Steam is supplied by two Scotch type two-furnace boilers working at a pressure of 120 lb. to the square inch. The pontoon having a central water-tight bulkhead right fore and aft, the suction pipes to either port or starboard pump are so arranged that in case of emergency either engine can pump the dock dry. Condensing plant is also fitted, and the dock is equipped with a self-contained electric power plant, the dynamo being driven by a "Petters" solid-injection oil engine supplying power for tools and lighting.

Mr. Fox said there are about thirty floating docks in the United Kingdom in use, of which about twenty-one are privately owned, and range from 400 tons to 5350 tons lifting capacity. The others, ranging from 1000 tons to 32,000 tons lifting capacity, are owned by the Admiralty. These numbers include the various box, offshore and bolted sectional types.

The larger pontoon owned by the Manchester Dry Dock Company, Limited, was removed during the war from the Ship Canal at Ellesmere Port by the Admiralty for use in Scapa Flow, where it rendered valuable services. The value of being able to transport a floating dock was again proved during the war, when the two Admiralty docks of 32,000 tons lifting capacity were towed to Jarrow-on-Tyne and Invergordon respectively, and were invaluable in docking crippled warships at a very critical period when docking facilities were vital in the North for our larger vessels in order to avoid the danger and loss of time in a run to the South Coast.

A Seven-Day Journal.

Memorial to Lord Rayleigh.

THE unveiling of a memorial tablet to Lord Rayleigh in Westminster Abbey on Wednesday gave Sir Joseph Thomson a fitting opportunity to pay a tribute in the presence of a distinguished gathering to a great physicist. For fifty years, Sir Joseph reminded us, Lord Rayleigh had pursued researches which were one of the glories of English science. Among them is the discovery of argon—the story of which is one of the romances of the research work. Lord Rayleigh was a pioneer in the investigation of flight problems, being convinced long before most people that the conquest of the air was not only possible but probable. The tablet in the Abbey bears his name, and records the two chief posts he held, with the simple description, "An unerring leader in the advancement of knowledge." It has been appropriately placed close to the memorial of Davy and Young.

Aeroplane Fuel Tank Tests.

THE testing for safety of the fuel tanks entered for the Air Ministry competition, which begins on Monday, will, it is hoped, show that such a tank is now available. A majority of the competitors, who number twenty-six, are British, but entries have been received from France, the United States, Italy, Belgium and Japan. The object is to obtain a fuel tank capable of withstanding the shock of an aeroplane crash without either bursting or leaking, in order to eliminate the risk of fire. The tank must be capable of being fixed within a space 2ft. 6in. by 2ft. 2in., and to have a capacity of 30 gallons. The money prizes offered amount to £2000, of which £1400 will go to the winner of the competition.

The State and Science.

ADVANTAGE was taken of the anniversary meeting of the Royal Society on Wednesday to emphasise the duty of those responsible for the allocation of State funds to make adequate provision for research work. The complaint of the President, Professor C. S. Sherrington, that it was pinchbeck economy to cut down the Government grant to the Universities, was a sound criticism. The need of a policy of national economy is, of course, admitted, but it is necessary to discriminate between expenditure upon the inessential and the essential. The necessary supply of trained research workers cannot be retained or replenished except by the pursuit of a steady policy. If the financial provision for research is too severely cut down, it will, as Professor Sherrington showed, mean the extinction of various investigations which cannot be satisfactory continued at all under narrower limits of expenditure than are imposed at present. To pull down under emergency what has been built up through years of careful experience and is proving efficient, can hardly be ultimate economy. The hope expressed by the President of the Royal Society that scientific research on its present maintenance will be considered part of the intellectual bread of the community, part of the bedrock on which rests the efficiency, not to speak of the industrial equipment, of the nation, will be widely shared. The Universities, on the one hand, and, on the other, the research institutions administered by the State, stand as an integral system, for whose existence adequate State provision is essential.

Liverpool University.

AT the yearly meeting of the University Court held on Monday last the serious condition of the finances of this institution was ventilated. The treasurer, Mr. C. S. Jones, said there had been a deficit of £26,000 on last year's working, making with the debit balance to July, 1920, a total deficiency of £37,600. By the end of the year the deficiency will probably amount to £50,000. Whereas the total expenditure of the University in 1911 was £74,000, this year it had been £220,000—apart from the fellowships and prizes—and the number of students has increased in the same period from 1200 to 2600. In making an appeal for further support from Liverpool citizens, Mr. Jones said it would be deplorable if the authorities had to decrease their expenditure by doing anything which would in any way lessen the efficiency of the education given at the University. They did not want endowment "chairs," but endowments which would enable them to carry on from day to day.

Closing Down a Leeds Works.

ONE effect of the amalgamation policy among engineering firms is the centralisation of manufacturing operations. It is with this object in view that the Leeds iron and steel works of Taylor Bros. and Co. are to be closed down and the business transferred to Manchester. The firm, which was established at Leeds over sixty years ago and under normal trade conditions employs about 2000 hands, is now merged in the Metropolitan Carriage and Wagon combine, and room will be found in the Manchester works of that company for the manufacturing operations of Taylor Bros. The Manchester shops have been designed and equipped in accordance with the most modern practice, and in addition to the saving in overhead charges which will be associated with the policy of concentration, production costs should be reduced by the saving in transport charges which will be effected by the removal of the works from an inland to what, owing to the Ship Canal, has become a seaboard city.

The Blacksmith's Art.

SIR WILLIAM ELLIS delivered a delightful popular lecture at Carpenter's Hall on Wednesday afternoon. His subject was "Modern Developments of the Blacksmith's Art," and, as will be readily divined, he dealt with the "art and mystery" of forging on the large scale—the making of gun tubes, hollow shafts, great chains, and so on. He claimed for the work of the smith that it had always been and still was, of all workshop crafts, the one that demanded the highest skill, for there was no appeal from it. The faults of the patternmaker were found out, the faults of the founder revealed themselves in the course of machining, but the faults of the smith—as, for example, in a defective weld—were hidden by a good exterior finish. The welding of links for big cables, said Sir William, was an art requiring very conscientious work, and it was doubtful if there were any other crafts in which a few minutes' carelessness might have such grave consequences. The lecture, of which the most interesting passages were the extempore interpolations upon the written words, were listened to with the closest attention by an audience of ladies and gentlemen, amongst whom there were but few possessed of technical knowledge. It demands no little skill so to handle a difficult and technical subject that the attention of a non-expert audience may be retained, and Sir William is to be heartily congratulated on his success. We may add that the object of the lecture was to encourage interest in the Worshipful Company of Blacksmiths, an ancient City company, of which it is thought the power for good that it once wielded might with profit be revived. We were interested to hear that a *rapprochement* between the old Company and the Iron and Steel Institute was being effected.

War Memorials to Mining Engineers.

THE unveiling by Lord Haig of the war memorials to members of the Institution of Mining Engineers and the Institution of Mining and Metallurgy has directed attention to the valuable work of a body of men whose services in the war have not in popular estimation been fully appreciated. There was no truce in the work underground, and it is well we should be reminded that it was carried out in every circumstance of peril present in a form which might well appal the most stout hearted. At Messines, on the Somme, and at Arras the tunnelling companies did magnificent work. The memorial of the Institution of Mining and Metallurgy, which has been erected at the joint premises of the two Institutions in City-road, consists of a small bronze figure of a tunnelling officer of engineers in the act of electrically firing a mine. It is erected on a pedestal of malachite, the face of which bears the names of the fallen. The second memorial is a female figure in bronze holding a banner. On a background of marble is the list of those who gave their lives in the war.

Safety of Life at Sea.

THE subject of technical interest which received attention at last week's Shipping Conference was the means to be adopted to ensure the safety of life at sea. Discussions took place both in connection with the subdivision of passenger ships and the provision of life-saving appliances in the form of boats, rafts, and wireless telegraphy installations. It will be recalled that the Merchant Shipping (Convention) Act of 1914, which dealt with these questions, has never become law, and in none of the maritime nations has the convention ever been ratified. An Order in Council which has just been published, authorises a further postponement of the Act, which should have come into force on January 1st. At the Shipping Conference the questions at issue were discussed from the economic as well as the technical standpoint, and the decision to appoint committees to consider and report upon the whole subject will be generally approved. The resolution passed by the Conference gave expression to the belief that safety of life at sea depends rather upon skilful navigation and the type and design of the ship itself than upon life-saving appliances. The resolution also stated that it would be undesirable to formulate hard and fast rules for the design of buoyancy apparatus, each of which should be considered on its merits by naval architects and shipbuilders in consultation with shipowners. Statistics were quoted showing that the percentage of persons saved in the event of disaster was to a great extent quite independent of the seating capacity of boats carried. With regard to wireless telegraphy, it was pointed out that the attempt to maintain constant communication required the introduction of an automatic alarm device which, it is understood, electrical engineers will be able to supply.

Railwaymen and Eight Hours' Day.

THE locomotive branches of the railwaymen's union have been raising the question of the eight hours' day in connection with drivers and firemen, and resolutions have been passed by branches of the Associated Society of Locomotive Engineers and Firemen refusing to work systematic overtime. It seems to be agreed that the character of the work of enginemen may make it necessary to work occasionally for a longer period than eight hours, and there is apparently no objection to overtime arising from the difficulty of arranging duties so that the eight-hour day shall not be exceeded. The object of the action which is now being taken by the unions is to abolish systematic overtime. It is hoped that there will be no attempt to draw a hard and fast line in this connection, as it is common knowledge that railway managements have been seriously embarrassed by the wholesale re-arrangement of the duties of trained men in accordance with the principle of the eight-hour day.

New Pipe Line from Thirlmere.

THE Manchester Corporation is now giving consideration to the laying of the fourth pipe line from Thirlmere to augment the water supply of the city. Tenders for the work have now been received, and it is anticipated that the contract will be placed almost immediately. It may be recalled that when the Thirlmere scheme was undertaken it was in contemplation to have five pipe lines, but subsequent investigation has suggested that the available supplies from Thirlmere would not warrant the laying of more than four conduits. The new aqueduct is to be 54in. diameter, and will, it is assumed, be constructed in steel except for a short length of reinforced concrete siphon in the vicinity of the river Ribble. The supply from the new conduit will be discharged into a new service reservoir at Heaton Park, having a capacity of 500,000,000 gallons. Preliminary work on the construction of the reservoir has been put in hand.

New Oil Fuel Depot.

GOOD progress is being made with the new fuel oil depôt which is being constructed at Jarrow for the bunkering of merchant ships. The total storage capacity provided for is 40,000 tons, and the first reservoir has been brought into use this week.

Cork Harbour Improvement.

CONSIDERABLE speculation has been indulged in as to the reasons which have induced the Cork Harbour Commissioners, as reported at a meeting held this week, to decide on securing the services of an American engineer to advise on an improvement scheme on which £1,000,000 is to be expended. The engineer in question is Mr. Nicholson, who is advisory engineer to the port of Seattle, and it need not be said that his qualifications to give advice are not in question. There are, however, it would be imagined, British engineers who are equally competent to deal with the Cork project. It appears, however, that the Board is rather expecting the Irish Parliament to foot the bill for obtaining expert advice. Further developments of the situation will be awaited with much interest.

Sydney Harbour Bridge.

TENDERS have just been invited for the construction of the long-talked-of bridge over Sydney Harbour. The design which has been approved is for a cantilever bridge of the single-span type. The distance between the two main piers will be 1600ft., and there will be a headway of 170ft. above high-water mark. The width of the bridge will be 140ft., and it will be divided into four sections. One of these will carry four lines of railway, another will be allocated to fast-moving motor traffic, the central roadway will be reserved for tramways, and heavy vehicular traffic, and there will be a special section for pedestrians. The length of the single span of the Sydney bridge will be 100ft. less than that of the central span of the Forth bridge, and 200ft. less than the long span of the Quebec bridge, but the Sydney bridge will exceed both these famous cantilever bridges in elevation above the waterway which it spans. The estimated cost of the Sydney bridge is £6,000,000.

LANDSHIPS, TURRET GUN-CARRIERS AND TANKS

(For description see opposite page.)

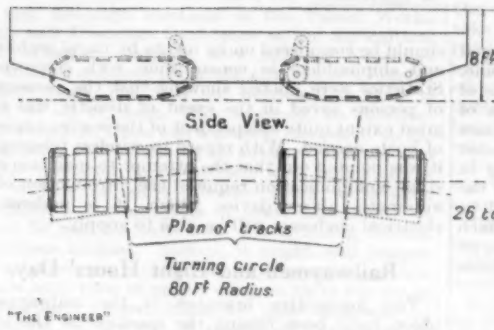


FIG. 1—BRITISH LANDSHIP TO CARRY 70 MEN

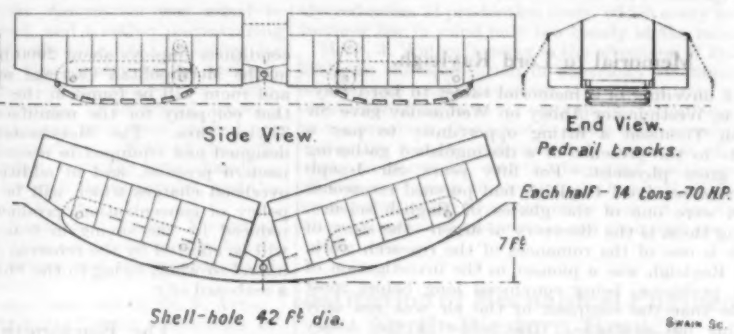


FIG. 2—BRITISH LANDSHIP TO CARRY 56 MEN

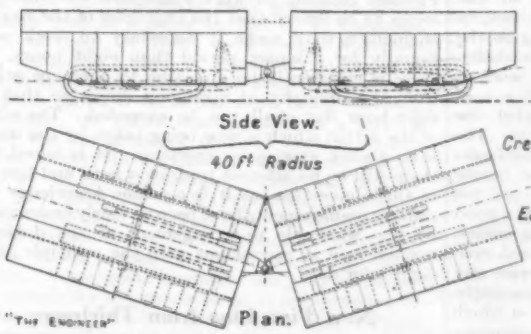


FIG. 3—BRITISH LANDSHIP WITH "CREEPING GRIP" TRACKS

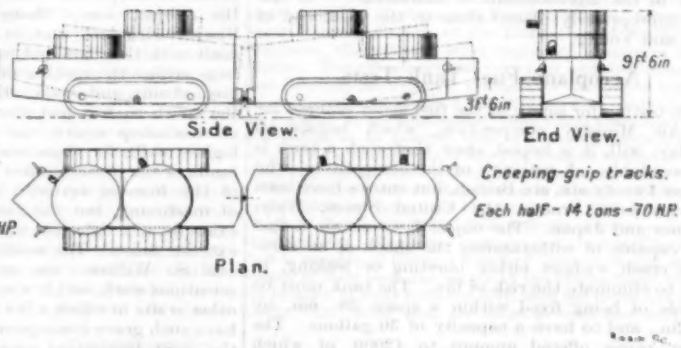


FIG. 4—BRITISH DOUBLE-TURRET GUN-CARRIER, 9-FEET 6-INCHES HIGH

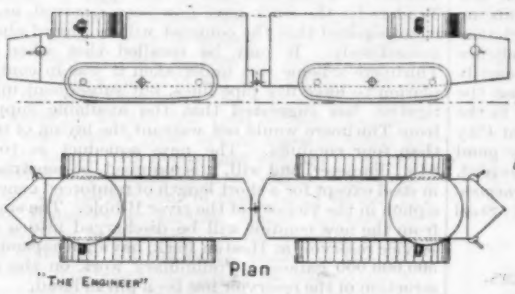


FIG. 5—BRITISH SINGLE-TURRET GUN-CARRIER, 7-FEET 6-INCHES HIGH

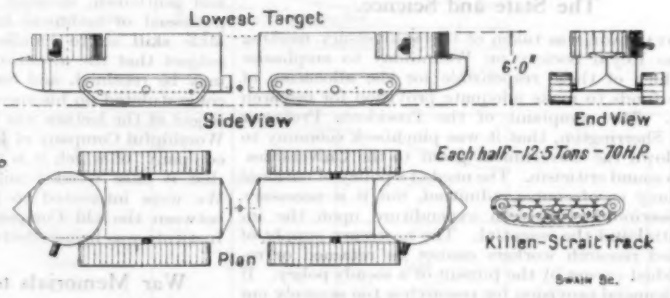


FIG. 6—BRITISH SINGLE-TURRET GUN-CARRIER, 6-FEET HIGH

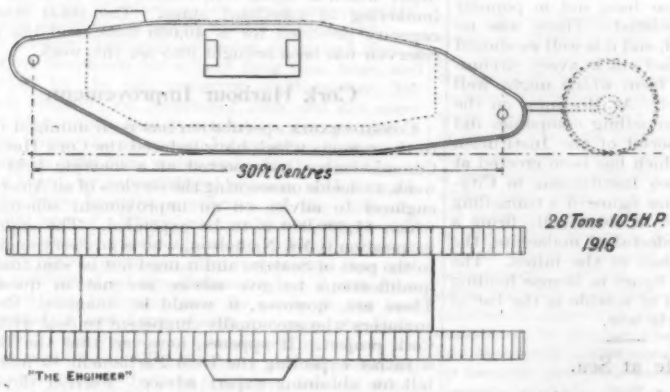


FIG. 7 ORIGINAL BRITISH TANK WITH TAIL WHEEL

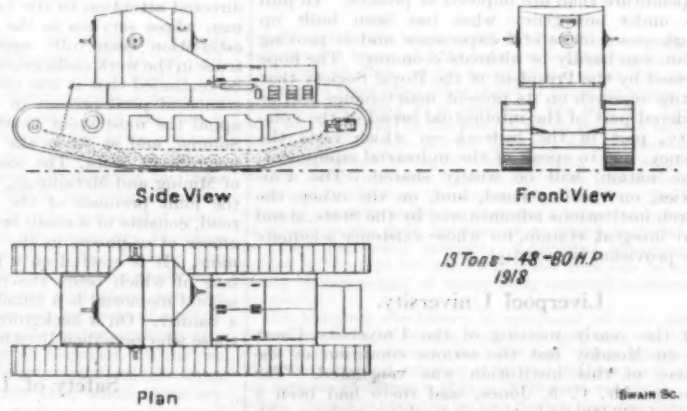


FIG. 8 BRITISH "WHIPPET" TANK—MEDIUM MARK A

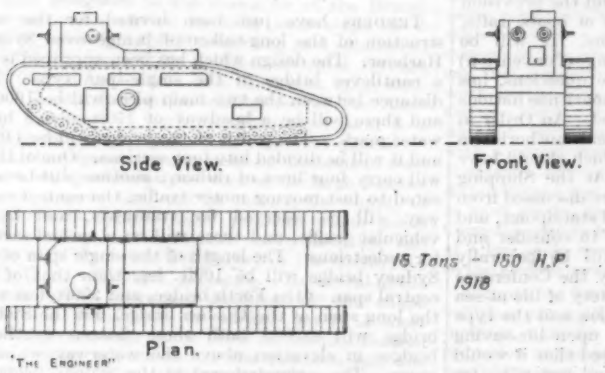


FIG. 9—BRITISH TANK—MARK C

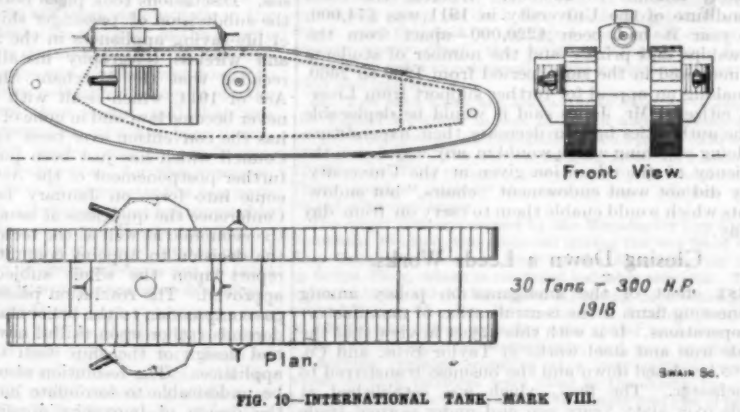


FIG. 10—INTERNATIONAL TANK—MARK VIII.

Tanks and Chain-Track Artillery.*

By L. A. LEGROS.

No. I.

DURING the last war appliances came into being based on the use of the chain-track as a method of propulsion, which are capable of being divided into two classes :—

(1) The "tank," as it is commonly known, an armed and armoured offensive machine, capable of running either on the road, or over uneven ground, trenches, embankments, barbed wire entanglements, &c.

(2) Chain-track artillery, capable of carrying heavy artillery, that is to say, an automotor cannon or howitzer, able to run over any kind of ground behind the firing line.

* * * * *

TRIAL AND EXPERIMENTAL PERIOD.

Methods for crossing the enemy defences were simultaneously the subject of investigation in France and in England at the commencement of 1915, when trench warfare began. In France, as in England, under the seal of secrecy and unknown to each other, engineers were working in adapting the caterpillar to military transport. The first designs were made in France by Messrs. Schneider et Cie., who had obtained two Holt caterpillars in January, 1915, the one having steering wheels and the other of the "Baby" type. These machines were used for tests at Le Creusot in May, 1915. It was found that the "Baby" type, without steering wheels, was capable of being handled very readily, and was suitable in principle for an offensive machine capable of running across country and traversing obstacles. Demonstrations were made in the presence of the President of the French Republic, June 16th, 1915. In July, Messrs. Schneider et Cie. commenced the designs for an armoured chain-track-driven motor vehicle. The apparatus was known as the tracteur armé et blindé. An order for ten of these machines was given to the constructors on December 15th, 1915. The machines were intended to be fitted in front with a wire cutter on the Breton-Prétot system. In the meantime, on the initiative of the deputy, M. Breton, the "Baby" caterpillar of Messrs. Schneider et Cie. was used for demonstrations on the uneven ground of the front—at Souain, on December 9th, 1915, and at Satory camp on December 27th, 1915. Trials were made with an upturned prow and rear wings, which increased its ability to cross obstacles, trenches, parapets, &c.

About the same time, Colonel (now General) Estienne, who had seen the Holt caterpillar at work on the British front, appreciated that the chain-track principle should render it possible to produce land ships which, if used in large numbers in conjunction with infantry, would afford invaluable help in offensive operations. Being placed in communication with the Schneider works on December 10th, he obtained every possible assistance from the firm, as well as being shown the design of the armoured motor machine-gun in a far advanced stage. A new design was at once put in hand according to the particulars which he supplied, and on December 27th, Colonel Estienne communicated the scheme for the Schneider-Estienne tank to G.H.Q. (G.Q.G.). In order to verify whether the dimensions adopted by Messrs. Schneider properly fulfilled the requirements involved in the crossing of trenches, the Automobile Technical Section made up a temporary machine of the same length of contact of the chain-track by combining the details of two Holt caterpillars. The trials took place on February 21st, 1916, at the Vincennes Polygon ; they showed that the proportions adopted by the constructors were suitable. Consequently, on February 25th, an order was given to Messrs. Schneider for 400 tanks in place of the previous order for the ten motor machine-guns. It is interesting and pleasant to announce that the trials and designs made by Messrs. Schneider were entrusted to our distinguished colleague, Mr. Eugène Brillié. Furthermore, the roughly constructed machine just mentioned, with tracks assembled from the parts of three Holt chain-tracks, served as a basis for a new pattern of tank, the design of which was undertaken by the firm of Saint-Chamond, and resulted in an order for 400 other tanks being placed with that firm. The details of these tanks will be dealt with later. The tanks were in the first instance styled armoured tractors, so as not to attract attention to their object ; later they were called "Chars d'assaut," the name which was given to them by General Estienne.

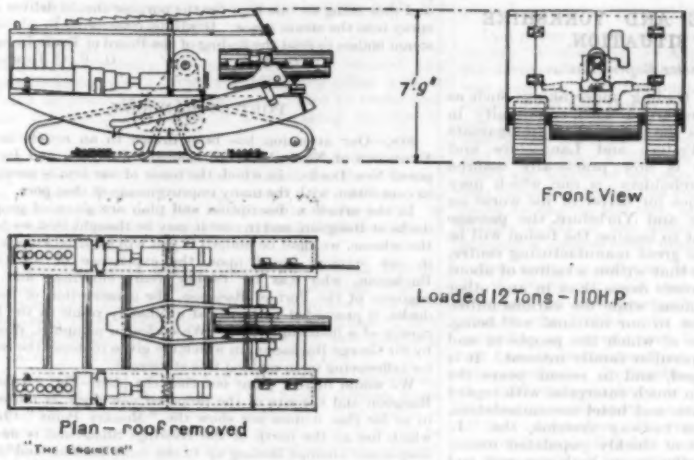


FIG. 11—BRITISH ARMOURED MOTOR GUN-CARRIER

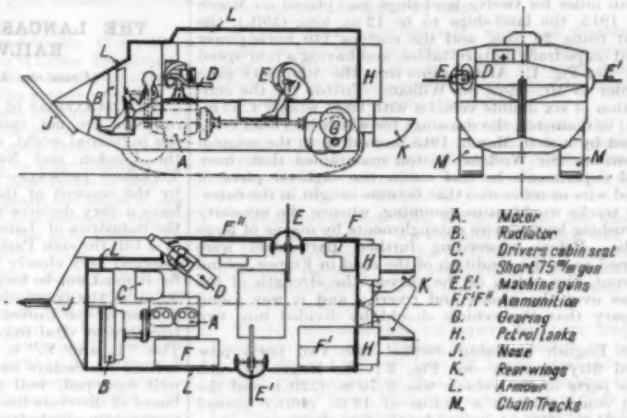


FIG. 12—SCHNEIDER "CHAR D'ASSAUT"

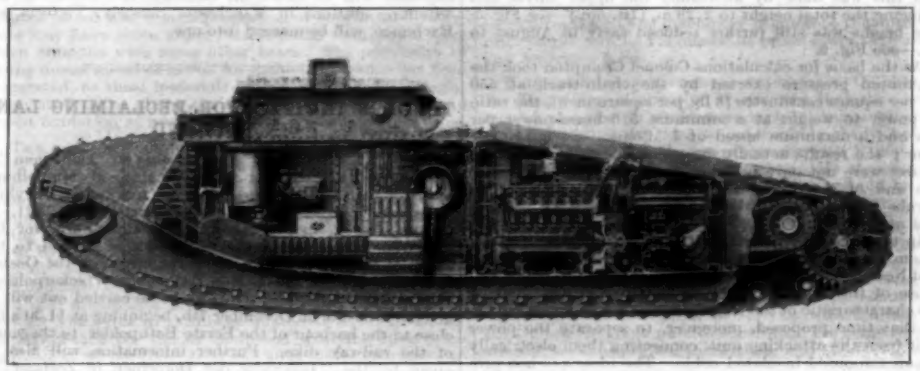


FIG. 14—INTERNATIONAL TANK, SHOWING INTERNAL ARRANGEMENTS

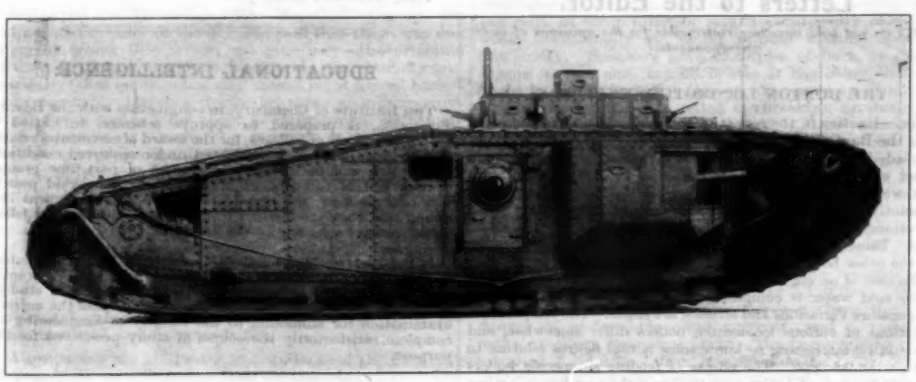


FIG. 13—INTERNATIONAL TANK

While these studies were being pursued in France, Mr. Winston Churchill, Chief Lord of the British Admiralty, formed in England, in February, 1915, a Committee known as the Admiralty Land-ship Committee, of which the consulting engineer was Colonel R. E. B. Crompton, C.B., R.E., and the assistant consulting engineer, L. A. Legros. A grant of £80,000 was assured by the British Treasury. From the commencement Colonel Crompton recognised that it would not be possible to use wheels, of any size whatever, for transport across marshy ground such as that of Flanders, and that the only method of overcoming the difficulty was to be found in the use of chain-tracks. He ordered immediately tractors of the Strait and Creeping-Grip types from America to serve as a basis for experiment, while attempts were being made to adapt the only English chain-track, the Diplock Pedrail, all the available Holt tractors being reserved for the use of the British Army.

It is interesting to note that in most countries, when a Government department is entrusted with work somewhat outside its proper province, it does not receive much help from those which it overlaps. England did not prove to be an exception to this rule, and Colonel Crompton, as Consulting Engineer to the Admiralty, was refused permission to visit the front and to ascertain on the spot the conditions of the ground and of the obstacles to be overcome. It was not till the end of July, 1915, that Colonel (now General) E. D. Swinton, C.B., D.S.O., was able to obtain particulars, semi-officially, on this subject, and to bring the necessary data for the definite design of a land-ship to England.[1]

France, the cradle of the automobile, and the neighbour of Germany, with the large variety of ground in which its frontiers lie, from the dunes of the north through the swamps of Flanders to the mountains of the Vosges, was thoroughly informed on these points and knew the difficulties only too well.

Of the American chain-track tractors available, only two were of possible value in the question of designing the tanks in England :—

(1) The "Baby" Holt, having a base of 1.63 m. (5ft. 4in.).

(2) The "Baby Creeping-Grip," having a base of 1.22 m. (4ft.).

Of these two tractors the "Baby" Holt was in use in the English Army as well as in the French, but it was not possible to obtain permission to use one as a basis of experiment for the land-ships. Only the "Baby" Creeping-Grip remained, and this could not be obtained at once, as the tractor was still undergoing trials and experiment at the works at Chicago. For this reason, foreseeing the necessity of a longer base than that of the "Baby," Colonel Crompton ordered caterpillar tracks of the "Baby" type lengthened and having a base of 2.75 m. (9ft.) in May, 1915. At first it was feared that the difficulties would recur that had already been found

* Abstract of paper read before the British Section of the Société des Ingénieurs Civils de France. September, 1921.

[1] The secret report of Major-General E. D. Swinton was worded thus :—"Caterpillar machine gun destroyers. Suggested conditions to be adhered to in design, if possible. These are tentative and subject to modification.

"Speed : Top speed on flat not less than 4 miles per hour ; bottom speed for climbing (blank) miles per hour. Steering : To be capable of being turned through 90 deg. on top speed on the flat on a radius of twice the length of the machine. Reversing : To travel backwards or forwards (equally fast). Climbing : To be capable of crossing backwards or forwards an earth parapet 5ft. thick and 5ft. high, having an exterior slope of 1/1 and interior slope vertical. Bridging : All gaps up to 5ft. width to be bridged directly without dipping into them. All gaps above 5ft. in width to be climbed (up to a depth of 5ft. with vertical earth sides). Radius of action : to carry petrol and water for 20 miles. Capacity, crew and armament : To carry ten men, two machine guns, one light quick-firing gun."

at the English manœuvres in 1908, when the "Caterpillar," pivoting on one track, dug itself in till it grounded. It was evident that, given the weight of the armour, the armament and the crew, the total would amount to several tons which, even under the most favourable conditions would double the total load to be carried on the chain-tracks. The lengthened chain-tracks of the "Baby" type were intended to serve for determining the proportions to be given to the chain-tracks for the actual land-ships.

The original idea of Mr. Churchill was that of transporting seventy infantrymen; the designs were commenced on February 25th, 1915, and were so advanced that an order for twelve land-ships was placed on March 20th, 1915, the land-ships to be 12 m. long (39ft.), the weight being 26 tons, and the engines 140 horse-power carried on pedrails on turn-tables, and having a four-speed drive—see Fig. 1. At the same time the Admiralty gave an order to Mr.—now Sir William—Tritton for the construction of six double vehicles with large wheels 4.55 m. (15ft.) in diameter, the drawings for which had been commenced by him in March, 1915, according to the original suggestion. Sir William Tritton maintained that, from actual experiments he had made, the slightest piece of barbed wire or other iron that became caught in the caterpillar tracks would cause jamming, whence the necessity for crushing barbed wire entanglements by means of large wheels. Before proceeding further, particulars were obtained as to the condition of the road in France behind the front, the radius of the curves, the strength of the bridges over the canals and rivers; and it was found necessary that the vehicle should be divided into two parts.

The English land-ship divided into two parts now carried fifty-six men—see Fig. 2; the length of each of the parts of the vehicle was 6.70 m. (22ft.), and the whole could turn in a radius of 12 m. (40ft.) instead of the 24 m. (80ft.) required by the first design.

On account of the difficulty of obtaining the Pedrail tracks, other designs were commenced on May 8th for a land-ship similar to the second, but with "Creeping-Grip" tracks—see Fig. 3. As the result of trials made with the Killen-Strait tractor in June, 1915—crossing obstacles and barbed wire—the consulting engineers received the order to abandon designs for carrying infantry and proceed with offensive cars. In consequence of the difficulty in crossing bridges and turning curves, designs were commenced in July 1st for a double land-ship with two superposed turrets for 75 mm. artillery; the total height amounted to 2.88 m. (9ft. 6in.)—see Fig. 4. On July 30th the height of this vehicle was required to be reduced, and this was done by abolishing the upper turret and reducing the total height to 2.29 m. (7ft. 6in.)—see Fig. 5. The height was still further reduced early in August to 6ft.—see Fig. 6.

As the basis for calculations Colonel Crompton took the maximum pressure exerted by the chain-track at 550 gr. per square centimetre (8 lb. per square inch), the ratio of power to weight at a minimum 5.5 horse-power per ton and a maximum speed of 7 kiloms. (4.4 miles) per hour; the results actually experienced showed that these figures were not only justified, but were exceeded before the end of the war. The trials made at Wormwood Scrubs before Mr. Lloyd George with the Strait tractor, and at Burton-on-Trent in August, 1915, with Creeping-Grip tractors gave inspiration to many inventors, among whom one may mention Messrs. Macfie, Wilson, Tritton and Nesfield. From these ideas were subsequently evolved those of the climbing and enveloping chain-track which are characteristic of the English tank. Sir William Tritton at that time proposed, moreover, to separate the power unit from the attacking unit, connecting them electrically by an armoured insulated cable. The idea was not proceeded with, but was later adopted in France by the firm of Saint-Chamond for heavy artillery.

The British Tanks.[1]

The chain-track offensive machines were called during the period of their construction in England "tanks," to distract attention from their object; this rather inappropriate name has been retained. The first tanks were put in hand in 1916. They were fitted with wheels at the rear, intended for facilitating steering and balance—see Fig. 7; later experience showed that the wheels were unnecessary. The first design included the climbing and enveloping chain-tracks passing over the top of the vehicle. It also included two lateral overhanging turrets (sponsons) removable for transport. Various arrangements for change of speed were adopted; in the first instance the sliding gear change was used, but later the epicyclic gear was adopted in the marks built in 1917 and 1918; trials were also made with hydraulic and electric transmission.

The "Whippet" (Medium Mark A)—Fig. 8—a high-speed machine-gun tank weighing 14 tons, was fitted with engines of 90 horse-power. Its maximum speed was 14 kiloms. (8.7 miles) per hour. In this mark, the chain-track is not of the enveloping pattern used in several British marks. Later an attempt was made to combine the principal features of the two first types in Mark C—Fig. 9. Finally, the International type (Mark VIII.)—Figs. 10, 13 and 14—shows the final type of 1918.

The first tanks revealed some defects due to want of appreciation of the essential conditions to be fulfilled:—

(*a*) Ability to run over any hard projecting obstacle; involving the concentrating of the whole of the load on one point of the chain-track.

(*b*) The angle-guides for the chain-track shoes; these had been arranged to hold up the lower portion of the chain-track in passing over trenches; it was found later that this arrangement was not only useless, but the cause of breakdown and of difficulty in dismantling the chain.

(*c*) Absence of springing, limiting the speed.

(*d*) In the early marks the co-operation of three or four persons was required for manœuvring; this made the driving extremely difficult.

Other War Material.—At the end of 1915, armoured motor gun-carrying tractors were suggested. Fig. 15 shows an armoured motor gun-carrier with a 4.5in. howitzer designed by Colonel Crompton. In the design made by Colonel Crompton at the commencement of 1916 the total load was 600 gr. per square centimetre (9 lb. per square inch), the ratio of horse-power to weight 9 horse-power per ton, and the speed 13 kiloms. (8 miles) per hour, with two motors capable of being coupled and disengaged and each fitted with epicyclic change gear. Gun-carrying tanks were constructed later by Major J. R. Greg, C.B.E., of the Metropolitan Amalgamated Railway Carriage and Wagon Company, in collaboration with Major Wilson.

(To be continued.)

[1] See account of the British tanks used in the war, by Sir Euston H. Tennyson d'Eyncourt, K.C.B., read before the British Association, 1919, and published in *Engineering*, September 12th and 19th, 1919.

THE LANCASHIRE AND YORKSHIRE RAILWAY SITUATION.

(From our Manchester Representative.)

Amalgamations of large trading undertakings such as railways are not usually regarded with equanimity in the industrial world, and as the proposal to amalgamate the London and North-Western and Lancashire and Yorkshire railways—which is now practically assured by the consent of the shareholders—is one which may have a very decisive influence for better or for worse on the industries of Lancashire and Yorkshire, the passage of a Bill through Parliament to legalise the fusion will be watched very closely in this great manufacturing centre, for it must not be forgotten that within a radius of about 30 miles the population is more dense than in any other portion of the United Kingdom, while the various industries are of vital importance to our national well-being. The "L. and Y." is a line of which the people in and around Lancashire have a peculiar family interest. It is well equipped, well managed, and in recent years the board of directors has shown much enterprise with regard to providing first-class station and hotel accommodation. Unlike many others of our railway systems, the "L. and Y." links up hundreds of thickly populated manufacturing towns direct with the sea on both our west and east coasts. It has also its own steamship services with ports at Fleetwood and Hull, while its suburban passenger traffic is also very heavy. Its identity will be sacrificed in the proposed fusion. It has been stated that the interests of the public will not suffer by the amalgamation, but business men will miss the keen competition which formerly took place between the two companies for traffic. This healthy competition may, of course, be compensated for by more economical working under the joint scheme, and the first step in the direction of reducing expenses will be taken on January 1st, when the two adjoining stations in Manchester, namely, Victoria and Exchange, will be merged into one.

TENDERS INVITED FOR RECLAIMING LAND IN HOLLAND.

The "Directeur der Registratie en Domeinen"—Director of Registration and Domains—at Middelburg, in Holland, will receive tenders, marked "Bedyking Kreekrak," on Wednesday, December 14th, 1921, at twelve o'clock, in "St. Joris," at Middelburg, for the execution of works for the reclaiming of ground to the south of the railway dike which runs through the Ooster-Scheldt, between the Eerste Bathe and Völckerpolders. Explanations regarding the work to be carried out will be given on the site on December 7th, beginning at 11.30 a.m., close to the harbour of the Eerste Bathpolder, to the south of the railway dike. Further information will also be given by the "Ingenieur der Domeinen in Zeeland"—Engineer of the Domains in Zealand—Middelburg, at whose office a list of these particulars may also be inspected on and after December 8th, 1921. Specifications and drawings are obtainable from the "Ontvangers der Registratie en Domeinen"—Collectors of Registration and Domains—at Middelburg and Goes, in return for a payment of 5 Gld. (about 9s.) per set, or from any other "Ontvanger der Registratie en Domeinen" in Holland.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

THE BUXTON LOCOMOTIVE EXPLOSION.

Sir,—I notice in the report of the inquest held in connection with the Buxton explosion that several theories have been put forward, but I am inclined to think that we must look for a better one. The researches of Myrom B. Wells have shown that when water, even warmed by the injector, is fed into a locomotive boiler, very large differences of temperature occur in various parts if the boiler is just simmering and not working hard. These variations of temperature cause enormous stresses. On the other hand, if the ebullition is violent, such as we have in the case of an engine running hard on the open line, the relatively cold water is completely mixed with the hot, and the temperature variations and stresses are slight. The temperature variations of various locomotive boilers differ somewhat, and it would be interesting to know some actual figures relating to this particular type. The effects of feeding simmering boilers are well known. A boiler may be "as tight as a bottle" when running, but may leak badly in the shed or siding if—and only if—the injector is used while the fire is more or less dead. The writer has known of cases in which as many as a couple of dozen tubes have been torn asunder by the use of an injector in a siding. It appears probable that the temperature variation theory is a much more satisfactory one than those mentioned at the inquest.

With regard to a sticking safety valve, can a driver be found in Great Britain who has ever known one to hold down after the normal pressure has been exceeded by 10 lb. or 20 lb.? We are informed that the injectors were troublesome. If the water level did fall, would not the fusible plugs act? Suppose they failed to act, would an uncovered crown sheet become seriously overheated if the engine were standing in a siding with a fire nearly dead? Now, as regards foreign matter: presumably scale is referred to. Was the boiler provided with an efficient or indifferent system of access for cleaning? A coating of scale may cause a plate to become overheated. Overheating is far more likely to occur when the engine is running hard, *i.e.*, when the temperature in the fire-box is really very high, and a film of steam is tending to keep the water away from the sheet. An engine in a siding is not likely to have its fire-box overheated.

This disaster might be compared with some marine boiler explosions, a paper dealing with which appeared in The Engineer about three or four years ago. In each case cited the ships were in port, the fires were very low, and the feed pumps had just been used. The quality of the metal was called into question, but not the stresses due to temperature variations. Injectors must be used to a certain extent on standing engines, and that being so, one kept for the purpose should deliver a fine spray into the steam space. It will be interesting to all users of steam boilers to read the finding of the Board of Trade Inspector.

G. F. C. Gordon.

PORT OF RANGOON.

Sir,—Our attention has been drawn to an article in The Engineer of November 25th headed "Rangoon and Its Proposed New Docks," in which the name of our firm is mentioned in connection with the many improvements at that port.

In the article a description and plan are given of proposed docks at Rangoon, and in case it may be thought that we favour the scheme, we shall be obliged if you will let it be known that, in our opinion, based upon the experience of Sir George Buchanan, who was for twenty years chairman and chief engineer of the Port of Rangoon, the construction of the wet docks, if proceeded with, would ultimately result in the bankruptcy of a flourishing port. We enclose a pamphlet, prepared by Sir George Buchanan, in which are given in detail the reasons for influencing us in making this statement.

We would further point out that the plan—Fig. 2—showing Rangoon and the site of the proposed new dock, is misleading in so far that it does not show the "Monkey Point" Channel which lies to the north of the Hastings Shoal, and is now the deep-water channel leading up to the inner harbour and import wharves at Rangoon. The King's Bank Channel, although used in former times, does not at present afford access for deep-water vessels up to the inner harbour as the plan would lead one to suppose.

C. S. Meik and Buchanan.

London, November 28th.

THE FIRST LOCOMOTIVE WITH FOUR EXCENTRICS.

Sir,—Mr. E. L. Ahrons, in his letter on this subject in The Engineer of November 25th, questions the accuracy of the statement that Forrester's locomotives were the first to have this improvement, and says that Hawthorn's Comet, put into service in March, 1835, was the first to have four excentrics. This view means either than Forrester's engines of 1834 did not have this gear, or that Hawthorn's engine was built before Forrester's.

We have it on the authority of Alexander Allan, who was with Forrester at the time, that the Swiftsure, and also the three Dublin and Kingstown engines, certainly delivered in the autumn of 1834, had the four-excentric gear, and he supplied a drawing of the latter which was published in The Engineer, Vol. 51, page 159. Even if there is an uncertainty in the date of delivery of the Swiftsure to the Liverpool and Manchester Railway, there can be no doubt about the Dublin and Kingstown engines being earlier than Hawthorn's.

E. A. Forward.

Wembley, Middlesex, November 30th.

A QUESTION AT THE "CIVILS" EXAMINATION.

Sir,—I shall be much obliged if, through your columns someone could give a possible solution to the following question which was No. 1 in Theory of Structures Paper set in the Associate Membership examination of the Institution of Civil Engineers in October last:—(1) Show that the bending moment diagram is the same for the load on a beam supported at the ends and uniformly loaded, as for the same load carried on two beams end to end each of half its length and supported at each end and at the centre of the first beam.

Solvers will, no doubt, note particularly the words "bending moment diagram."

Conrad Gribble.

York, November 25th.

EDUCATIONAL INTELLIGENCE.

The Institute of Chemistry, in conjunction with the Board of Education, is prepared to approve schemes, submitted by technical schools or colleges, for the award of certificates relating to courses in chemistry conducted under approved conditions. Certificates will be awarded in respect of part-time grouped courses and of full-time grouped courses. To avoid possible misunderstanding, the certificates will bear a statement indicating that they are distinct from the associateship and fellowship diplomas awarded by the Institute.

It has been decided by the University of Bristol to conform to the practice of most other English Universities by granting a diploma (in lieu of a certificate) in engineering to students who, though not qualified for matriculation, pass the entrance examination for admission to the Faculty of Engineering and complete satisfactorily the course of study prescribed for that purpose.

A new type of locomotive, known as the "C 1" class, has recently been put into service on the Victorian Railways. The first engine of the class, which was constructed in the department's workshops at Newport, has given excellent results in hauling goods trains on the north-eastern division of the railways. The engine, which has a tractive force of 36,138 lb., has wheels of 5ft. diameter, so that it can attain fairly high speeds. There are eight wheels, and they are all coupled. The valve gear is of the Walschaerts' type. There is a superheater and a device for emptying the smoke-box and ashpan by mechanical means instead of by hand. Five more engines of the same type will be delivered from the Newport workshops before the end of the year, and a further fourteen will be completed during 1922.

Railway Matters.

THE railway bridge over the Dwina, which was damaged during the war, will shortly be reopened.

A NEW form of detonator is being used on the Canadian Pacific Railway which appeals to the three senses of hearing, seeing, and smelling. In addition to the sound of the explosion there is a brilliant flash and a pungent smell.

THE Ministries of Agriculture and Transport have been discussing the question of the best type of vehicle for the conveyance of milk, and the matter is receiving the attention of the railway companies in connection with the building of new rolling stock.

A CLAUSE in the Bill that will be deposited by the Metropolitan Railway Company seeks to remove any disqualification from a director holding any office or place of trust or profit under the company, also to make provision for the appointment of a managing director or directors.

THE Indian Railway Board has sanctioned a survey being carried out by the Baroda Durbar for the following lines:—Maroli-Vesma-Mahuva, about 18 miles, and Butwara-Songad, about 30 miles. The survey will be known as the Maroli-Vesma-Mahuva and Butwara-Songad Railway Survey.

SYRENS similar to that installed at Victoria District Railway station, for automatically announcing when a prescribed number of seconds have expired, are to be fixed at Charing Cross (District Railway), Tottenham Court-road (Hampstead and Highgate Railway), and Elephant and Castle (City and South London Railway).

WE learn on good authority that the work of electrifying the Glencoe-Maritzburg section of the South African State Railways is to be commenced immediately. The length of the section is approximately 170 miles, and it is to be electrified on the high-tersion direct-current system. Messrs. Merz and McLellan are the consulting engineers.

THE Great Eastern, South-Eastern and Chatham, and the London, Brighton and South Coast Railways have introduced "shopping tickets," to be issued from certain stations to London on any day of the week except Saturday and Sunday between 10.30 a.m. and 4.30 p.m., and available to return the same day before 5 p.m. or after 6 p.m.

THE whole question of the future development of the inland waterways of the country is, said Mr. Arthur Neal recently, still under consideration by the Committee presided over by Mr. Neville Chamberlain, and until it reported and a general policy was settled it was not possible to say anything as to the conditions and prospects of the Sheffield and South Yorkshire Canal.

AT the Institute of Transport on November 14th, Mr. Kelway-Bamber, who has recently been to South Africa, said that the coal traffic there was conveyed in self-discharging bogie hopper wagons of 38 to 45 tons capacity; a typical train load, despite the severe gradients in places, was about 900 tons in twenty wagons. Passenger loads were 275 to 455 tons behind the tender.

A FATAL collision occurred at the New-street station of the London and North-Western and Midland companies, Birmingham, on Saturday afternoon last. An express from Bristol ran into a stationary train, crushing two vehicles of the latter. Two men and a baby were killed. Colonel Pringle was holding an inquiry on behalf of the Ministry of Transport yesterday (Thursday).

THE Midland Railway Company used to issue zone tickets in the Sheffield district, but these tickets were abolished on October 31st. The explanation given is that the season ticket rates now in force are cheaper. The company is under no statutory obligation to issue them, and if any member of the public feels that there is a grievance the Railway Rates Tribunal may be approached.

THE announcement is made that English and Chilean interests have completed financial arrangements for the construction of a railway between Los Andes, Santiago and Valparaiso. The line will be an extension of the narrow-gauge Transandine railway, and will thus provide direct communication between Mendoza, Argentina and Valparaiso. At the present time passengers travelling across the continent have to change at Los Andes.

SPEAKING on November 19th, Mr. C. T. Cramp, the industrial secretary of the N.U.R., said that there was one thing on which they would not give way—the principle of the eight-hours' day. He would also say, candidly and fearlessly, that eight-hours' day meant eight hours' honest work per day. In other words, let them give twopenny-worth for twopence. Let them, as railwaymen, endeavour by co-operation to make the railways so remunerative that the companies could give the best conditions to them.

A SPECIAL notice, dated September 5th, has been issued by the general manager of the South African Railways and Harbours, saying that after the fullest and most sympathetic consideration, the Government has reluctantly come to the conclusion that it is impossible to continue the universal eight hours' day or forty-eight hour week, irrespective of the intensity and continuity of the work done. From the 12th idem. the ordinary working hours for drivers and firemen were to be nine per day, for ticket examiners ten, and for guards ten.

ADDRESSING the graduates and students of the Institute of Transport on November 18th on the subject of "The Operation and Development of Urban Electric Railway Services," Mr. J. P. Thomas, the operating manager of the Underground group, said that on the group's system there were 80,000 station stops made daily, and the electrical energy absorbed in the normal starting of trains was more than one-third of the total day's output of the generating station. The interval between stations on any new lines should be widened and the diffusion of traffic between stations provided for by surface transit. Consideration should also be given to the plan of equipping the stations with four tracks, two in each direction, to allow of trains loading and unloading whilst the following trains ran in to the adjacent platforms. Speaking of the necessity for more railways, Mr. Thomas said that it took as long to go from Edgware to Purley as from London to Birmingham.

Notes and Memoranda.

WRITING to the *Engineering News Record*, Mr. J. M. Garrett says that in 1835 the City of Pensacola, Fla., attempted to build a railway northward toward Montgomery, Ala., but the project failed in 1837. In 1908 he made a survey over the old line, which was overgrown with long leaf pines from 6in. to 15in. in diameter. He found five lightwood knot fat pine stakes of the original survey, two on the centre line and three on the slopes. In size they were about 2in. by 3in. by 36in. All of the stakes were sound, and seemed to be in as good condition as when placed, over seventy years before.

IN a paper which was recently read by Mr. C. W. Boyle on the "Poulsen Arc as Applied to Wireless Telegraphy," the design of the arc generator for high-frequency currents was gone into very thoroughly. The author said that the shape of the pole tips of the magnets was important; the gap between them was fixed by the power of the arc or size of the electrodes. The pole cores should be round, and should have a diameter equal to approximately four times the length of the gap. The best shape of pole tips was conical, with the tips cut off square, the angle of slope being 55 deg. to the face, and the face diameter approximately 0.433 of the diameter of the pole cores. This ensured a concentrated magnetic field in the gap.

SPEAKING recently at the Dublin Rotary Club, Mr. E. C. Handcock said that electric cooking was not so expensive as was commonly believed, and demonstrated that, at the Dublin rate, a 5 lb. joint of beef could be cooked in an electric oven for 2d., while a 6 lb. joint lost but 1 oz. in electric cooking, against 25 to 30 per cent. by other methods. In Dublin, he said, there were some of the best lighted shops in the United Kingdom. The lighting in some spots, as in Grafton-street, was superior to that of London. He regretted that many unqualified men undertook electrical contracts, but rejoiced that now, as the result of the charter granted to the Institution, only chartered electrical engineers would be recognised as qualified and competent.

SOME experiments carried out in America on wire gauzes for miners' safety lamps indicate that for conditions of high temperature, steel is superior to either brass or copper. For low temperatures, the advantage of steel over brass or copper is little. Brass or copper might be preferred by some, although one who knows the insecurity of such gauzes at high temperature might be unwilling to trust them, even though the probability of high temperatures was remote. Brass is more satisfactory than copper, but the brass gauzes tested had a high proportion of copper, and therefore may have given much better results than would have been obtained with some other brass. The possibility of using monel metal or nickel for flame-lamp gauze has been suggested, as these materials have a higher melting point than steel, have about the same heat conductivity, and resist oxidation at atmospheric and at high temperatures.

THE total production of iron ore in Sweden during the year 1920 was 4,519,112, or 9.3 per cent. less than in 1919. The reduction was greatest in the county of Norrbotten and a small increase is reported from the county of Kopparberg. The value of the ore was Kr. 67,932,757, being an average price per ton of Kr. 15.03, compared with Kr. 71,585,036, or an average price of Kr. 14.37 per ton in 1919. The production of iron pig amounted to 470,550 tons, or 4.7 per cent. less than in 1919, which year had also a very low production compared with previous years. The value in 1920 is estimated at Kr. 119,903,514, or Kr. 254.82 per ton as compared with the 1919 price of Kr. 236.65 per ton. Iron and steel alloys amounted to 13,624 tons, valued at Kr. 8,068,053; but of ferro-silicon only 6281 tons were produced, as compared with 11,705 tons in 1919. 4263 tons of iron sponge were produced in 1920, as against 1332 tons the previous year. The output of malleable iron and steel was, generally speaking, less than that in 1919.

DURING the discussion of a paper on British and Belgian methods of rolling, which was read before the Staffordshire Iron and Steel Institute by Mr. L. G. Harris, which is reported in the *Iron and Coal Trades Review*, Belgian rolling methods were sharply criticised, especially from the point of view of the iron mixtures, nearly all the speakers emphasising the opinion that so large a quantity as 80 per cent. of scrap must be fatal to uniformity of quality, while occasionally it would impose strains upon the machinery. Speakers gave examples of bars, tough and fibrous at one end, but so brittle at the other that they could be easily broken. One speaker gave an example of Belgian iron which had failed by breaking up during the process of cutting a screw thread. There was general agreement that the quality of Staffordshire iron could not possibly be maintained if scrap were largely used. On the question of output, examples were cited of British furnaces giving an output quite as satisfactory as that obtained in Belgium, but it was pointed out that the frequent roll-changing resulting from very small orders here involved a great waste of time and reduced output.

A NON-MAGNETIC iron of high specific resistance has recently been introduced by Ferranti, Limited. Its low permeability makes it suitable for use where there is a danger of undesirable eddy currents, and it is said to make excellent resistance grids. The permeability of this so-called "No-Mag" iron is approximately the same as that of brass, careful tests having given a value of 1.03 as compared with unit permeability for air. The resistance is nearly 50 per cent. greater than that of ordinary cast iron, the precise value being 140 micro-ohms per cubic centimetre as compared with 95 for ordinary cast iron and 7.5 for brass. The effect of change of temperature on the resistance is less than in the case of ordinary cast iron, the temperature coefficient between the limits of 0 deg. Cent. and 100 deg. Cent. being .0009. It is slightly less permeable with increasing temperatures. At 17 deg. Cent. the permeability is 1.025, and at 100 deg. Cent., 1.020. The metal can be cast with the same ease as ordinary iron, and it has the same appearance and machining qualities. Its mechanical strength closely resembles that of cast iron, but it is more malleable. The cost of castings varies from 50 to 100 per cent. more than ordinary iron castings, according to size

Miscellanea.

ACCORDING to the *Manchester Guardian*, 8000 Leicestershire miners received, on Tuesday last, fourteen days' notice to finish their employment unless they are prepared to use forks instead of shovels for filling the coal tubs in the mines.

IN order to provide facilities for bunkering ships with liquid fuel in the docks at Bombay a special pipe is being laid between the Wari Bunder installations and the oil berth, Alexandra Dock harbour wall. The estimated cost of the work is about Rs. 3½ lakhs.

HAVING sold 6,000,000 dols. worth of machinery in Australia last year, the Massey Harris Implement Company, of Montreal, Canada, is now reported from Vancouver to have announced its intention to establish a manufactory in the Commonwealth.

PRELIMINARY work in connection with the Sukkur barrage scheme was about to be started, according to a recent issue of the *Indian and Eastern Engineer*. The portion to be surveyed this season is the tract from Ruk to Sehwan, on the right bank of the Indus.

A COMPROMISE has been arrived at on the white lead question at Geneva. An amendment, which was carried by 76 to 3, provides for the prohibition of white lead only in interior painting. The prohibition of white lead is not to come into force until six years after the present session of the Conference.

WE are informed that an inquiry has been made by a prominent American group of steel makers to purchase no less than 1,000,000 tons of heavy steel scrap from English merchants, and that an offer emanating from the Midlands and South Wales to supply part of that amount has been made at prices which it is expected will prove acceptable.

AS a token of good will, and in recognition of the generous hospitality shown by the Amir and his Government towards his mission, Sir Henry Dobbs announced on November 23rd that the British Government in India had decided to present to the Afghan Government sufficient telegraph material to link up the 460 miles separating Kabul from the Indian telegraph extension at Herat *vid* Kandahar.

REPORTS show that German machinery suppliers are steadily regaining the markets in Japan. Immediately after the war, it is said, Japanese machinery orders were placed with Germany only for special goods peculiar to German manufacturers. Subsequent trial orders, however, have proved that the machinery is equal to that produced prior to the war, and is offered at prices lower than British and American goods.

WHEN delivering his annual statement in October last, the Tasmanian Minister of Works said that the Government hydro-electric works were rapidly approaching completion, and that the Department would be ready to supply the Electrolytic Zinc Company's works with 15,000 horse-power of current early in November. He thought, too, that the whole of the Great Lake scheme would be completed by about October, 1922.

THE British Consul at Vigo reports that German trade propaganda is very active in Spain and that German commercial travellers are to be seen there as busy as before the war. German trade papers in the Spanish language are circulated widely among the commercial community, and the Consul contrasts that activity with the fact that the United Kingdom publications which are being received are still usually printed in English, and therefore, as far as the Spanish commercial community is concerned, serve no useful purpose.

THE Housing Committee of the London County Council reports that it has accepted a tender for the erection of 83 additional houses—40 of five rooms and 43 of four rooms—to complete the development of the Old Oak Estate, Hammersmith. The total expenditure, with statutory fees, &c., will be £57,722. It is pointed out that on the basis of the lowest tender for the work the figures show a decrease of about 31 per cent. on prices current during the latter part of 1920. The average cost per house based on tender is now £696, a reduction of £292 per house.

THE Council of the Surveyors' Institution has accepted an invitation from the Shropshire, Herefordshire and Mid-Wales branch to hold the annual country meeting at Shrewsbury in 1922. The Council has also decided that the interest from the bequest of £500 by the late Mr. T. T. Wainwright, past president, shall be applied for the purpose of awarding a prize to the non-student candidate who obtains the highest number of marks in the intermediate and final examinations combined. The prize will correspond with the Galsworthy prize for student candidates.

AN important water-supply scheme is to be carried out by the Whitehaven Rural District Council and the Harrington Urban District Council, Cumberland, at a cost of £48,000. The scheme, which will provide work for a large number of unemployed, will serve the parishes of Lamplugh, Distington, Moresby, Parton, and Harrington, and, possibly, one or two parishes in the Cockermouth rural area. According to the *Newcastle Daily Chronicle*, the water supply will be transferred from springs at Lamplugh, Ousen, and Mosser Fells, by gravitation to three large reservoirs, and there will be about 14 miles of water mains.

THE project which had existed for years of supplying Boryalaw with water from the Sryj River at Kropownik is, it is reported, at last to be carried out. It is intended to lay a pipe line 15 kiloms. long, and for that purpose to form a company with a capital of 200 million marks. The founders of the company are the Ziemski Bank Kreditowy, Lemberg, and the Tustanowice Water Supply Company at Boryslaw. The project is of great importance for the petroleum industry, since up to the present the water obtained from the brooks at Boryslaw and Tustanowice have proved insufficient for boring operations, especially in seasons of great drought and sharp frost, so much so that at such times boring operations have had to be suspended.

NEW ELECTRIC GENERATING STATION AT RUNCORN

MESSRS. MERZ AND McLELLAN, LONDON, ENGINEERS

(*For description see page 584*)

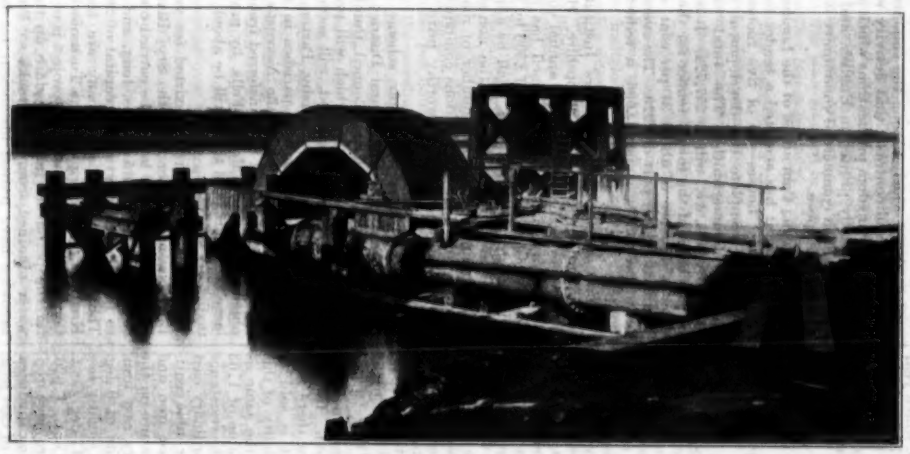


FIG. 10—ROTARY SCREEN FOR THE CIRCULATING WATER

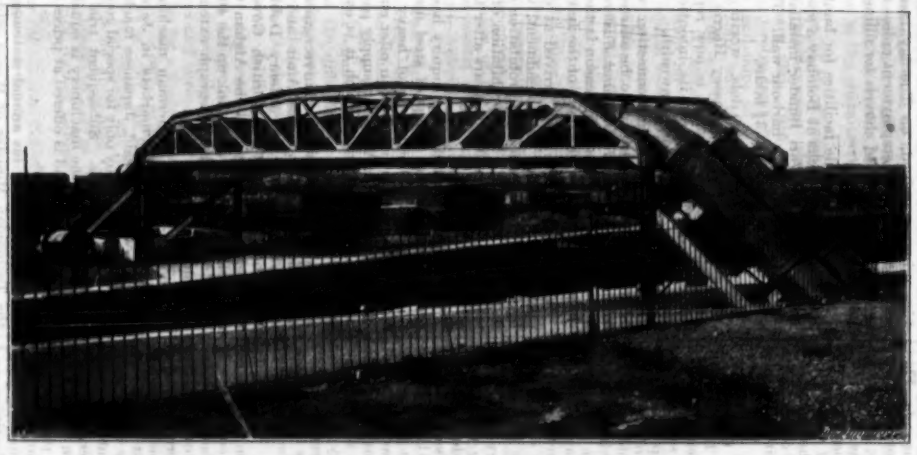


FIG. 11—CIRCULATING WATER PIPE LINES OVER THE RUNCORN AND WESTON CANAL

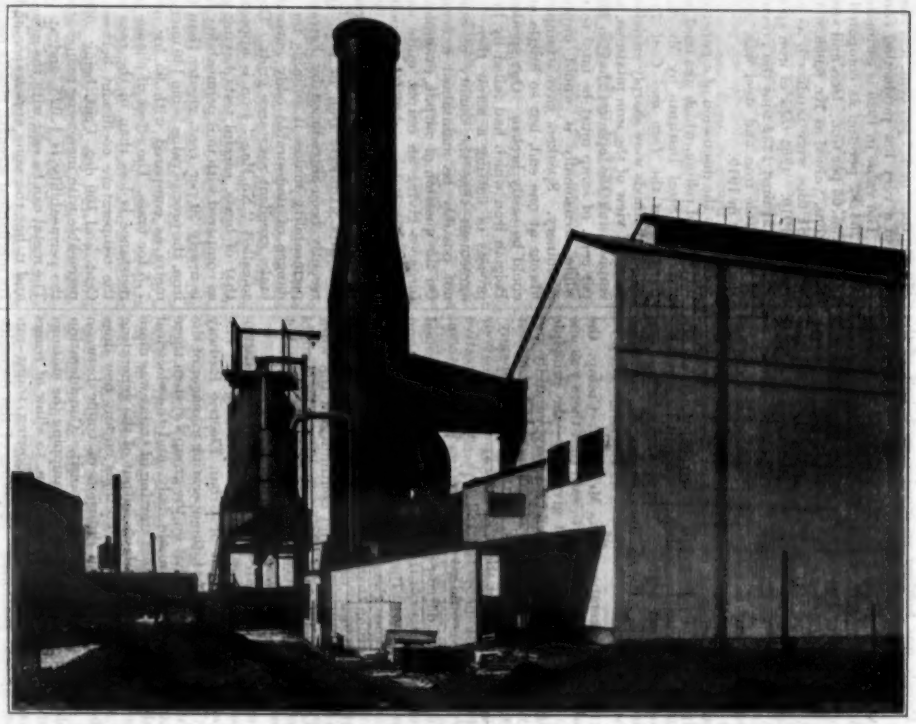


FIG. 12—VIEW SHOWING ASH RECEIVER, FILTER AND FAN DUCTS

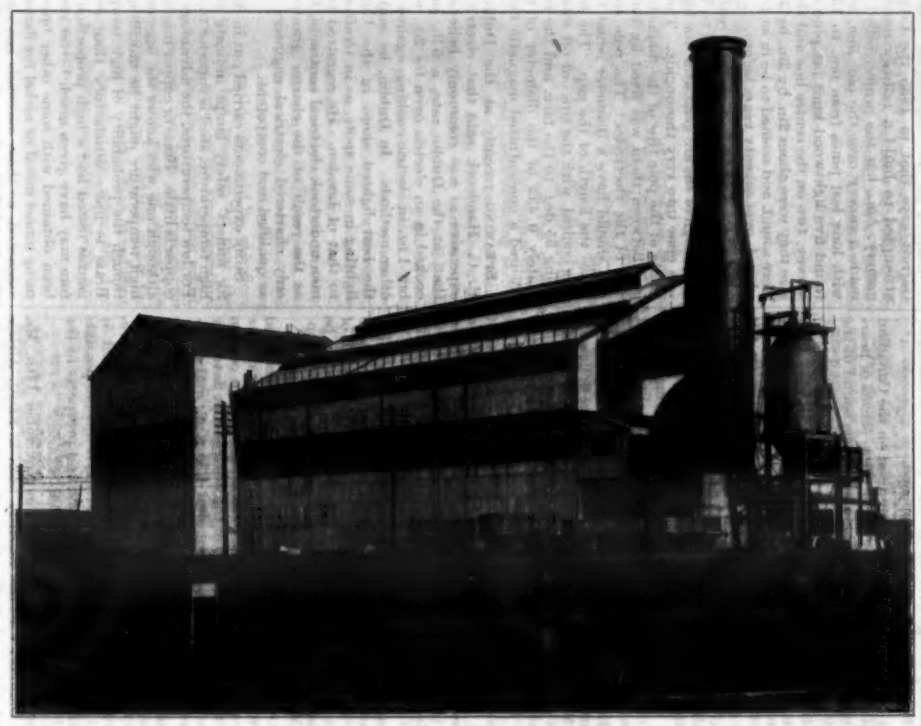


FIG. 13—GENERAL VIEW OF THE STATION

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The Engineer

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By arrangement with Reuter's Engineering Service, **The Engineer** *contains the latest news from all parts of the world which is likely to be of interest to engineers.*

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DEATHS.

On Monday, 28th Nov., at Ealing, FULWAR CRAVEN FOWLE, M. Inst. C.E., late Deputy Chief of the G.I.P Railway, Bombay, eldest son of the late Fulwar Craven Fowle, I.C.S., of Amesbury, Wilts.

ON the 22nd November, at a nursing home, Folkestone, MANSFELDT HENRY MILLS, F.R.G.S., M. Inst. C.E., M.I.M.E. aged 68.

THE ENGINEER.

DECEMBER 2, 1921.

Wireless Developments.

IT is perhaps scarcely necessary to emphasise in these days the importance that should be attached to the discoveries that have been made and the practical work that has been undertaken in connection with radio communication. So much has been published concerning the achievements of those who have devoted themselves to this fascinating branch of science that further comment may appear uncalled for. There is little doubt, however, that, although it is pretty generally known that it is now practicable to send a message half-way round the earth from Ireland to New Zealand, the full significance of the latest developments is only properly appreciated in wireless circles. It is true, of course, that there is an enthusiastic body of amateurs who carry out experiments and take an interest in the work generally; but the people to whom a knowledge of wireless matters is most essential are those who are likely to derive some sort of gain from such knowledge in connection with business. It is essential, for instance, that the full value of wireless applications should be properly understood by all who are associated with shipping.

Lectures which are supplemented by practical demonstrations of the use of electro-magnetic waves in connection with telegraphy, telephony, and direction finding are invariably well received, and whilst listening last week to a lecture delivered by Professor E. W. Marchant before Lloyd's Register Staff Association at Lloyd's Register of Shipping in Fenchurch-street, we were impressed by the keen interest displayed by the audience. Having covered a good deal of ground, the lecturer announced, to the obvious surprise of nearly everyone present, that for the time being he had to stop talking, as he had arranged with someone in Paris to send through some signals, which were due to arrive. Almost exactly at the appointed time these signals emanated from a large telephone receiver on the lecture table so that they could be heard distinctly throughout the room, whilst shortly afterwards signals arrived from a ship at sea. Demonstrations of direction finding were also given, and towards the close of the meeting speech was received on the wireless system from Marconi House. Although these results are not, of course, by any means exceptional, they undoubtedly caused those who had not hitherto witnessed wireless experiments to realise more thoroughly than before the state of perfection to which this branch of science has been brought and the value of the most modern appliances. From the point of view of shipping people the wireless direction finder, which has been developed very largely by Captain Round, is a device of great value. It is perhaps not generally known that during the war wireless direction finding enabled the movements of the German fleet to be ascertained with a good degree of accuracy. Indeed, it is said that had it not been for Captain Round's activities in this direction the Battle of Jutland might never have been fought. Finding that the German fleet was sending out a great number of wireless signals, he communicated the fact to the Admiralty, and as a result of the use of the direction finder the British and German ships were brought into conflict. Our direction finding was, it seems, far in advance of that of the Germans, who had no conception that we could find the position of their boats with the facility we actually achieved. Clearly, however, the scheme is not only applicable to war operations of the above kind, for if a man on a ship or a boat can find the direction from which signals of two known stations are coming he can determine his own position with a degree of accuracy, which depends only on the precision with which he can find direction.

One of the drawbacks that has always been urged against wireless telegraphy is that anyone can pick up signals, but great improvements have been made within recent years in the selectivity of receiving sets, and it is now possible to have a number of stations with comparatively small differences in electrical pitch working close to each other. An even more important development has been the discovery of the thermionic valve. Nowadays it is possible to pick up signals from all over Europe on a small coil a few inches in diameter, and to amplify them sufficiently with these thermionic valves to make them loud enough to be heard all over a large room. Theoretically there is no limit to the amplification that can be obtained with thermionic valves connected in cascade. However, practical experience shows that when the amplification exceeds a certain limit the valves themselves produce noises in the telephone and make the hearing of signals difficult. This defect will probably be overcome in due course, but in any case the thermionic valve is one of the most useful devices that have been introduced into wireless work. All the great feats of long-distance wireless telegraphy of late years, such, for instance, as receiving messages from half-way round the earth, have only been achieved by utilising cascade connected thermionic valves. It is to be remembered that besides acting as detectors and amplifiers, these valves will also generate continuous oscillations. Whilst experts differ widely as to the relative advantages of the high-frequency alternator, the arc, the timed spark, and the thermionic valve as generators for high-power stations, it is pretty well agreed, we believe, that it is the thermionic valve generator that has made wireless telephony possible over immense distances. What the ultimate outcome of wireless work will be we do not know. Progress of late has been so rapid and so remarkable that new achievements have almost ceased to be surprising. It is pretty certain that a state of finality has not by any means been reached, and the next ten years or so may possibly lead to developments which will almost completely eclipse the wonderful work that has already been undertaken.

Tataism.

So ignorant are we—and we confess it with some pride—of the jargon of the newest developments of art that until a few weeks ago we had never heard of Tataism, or, if we had done so, we imagined, in a vague way, that it had some relation to a celebrated Indian firm. We have learnt recently from Mr. Nevinson's preface to a catalogue of post-futurist pictures that Tataism is in fact "the tendency of moderns to group themselves together, only to break away with loud and abusive farewells." From which we understand that it is a kind of disruptive good-bye-ism or, more correctly, fare-ye-ill-ism. Whilst our philological sense is, rather pleasantly, offended by the word, we find ourselves forced to admit that the definition, if not the word itself, does present the kernel or nucleolus of a fact. For who can doubt that in recent years we have seen a surprising development of the "tendency of moderns to group themselves together," and that already there are signs and portents of "breakings away with loud and abusive farewells." Have we not seen recently the voluntary cision of the "safety-men" from the Miners' Federation, the disruption of the tube combine, and important changes in a yet more famous and more openly conducted amalgamation?

At the first blush one would imagine that great combinations of many firms savoured of socialism,

and that they would be imbued with whatever elements of good there may be in that impracticable system. The principles indeed are the principles of the socialist—the co-operation of many for the good of all—but the practice, in fact, more nearly assimilates to a modern form of despotic feudalism, with the over-lord sometimes a chief or a board, but more often a tyrannical System with no human bowels and no human sympathies. These combinations originate in the financial mind and are rarely viewed with sympathy either by technical men or by factory managers. The idea underlying them is the reduction of clerical staffs, the removal of competition, and the accumulation of funds for such extensions that monopolies and power may be secured. It would be instructive to know their history. We fancy it would show that in nine cases out of ten the best-laid schemes "gang agley." Staffs are indeed reduced for a time by the wholesale dismissal of the more expensive members, but before long they mount up again by the addition of numerous petty clerks for the administration of system and the total outlay on unproductive workers is at least as great as ever; competition, we know, is never effectively killed and monopolies are never secured. Power there is indeed; but, as we have seen lately in the case of a famous organisation, it cannot avert something very like disaster when great stress has to be faced. Loose amalgamations—amalgamations, that is to say, which leave very nearly perfect independence to each member—serve frequently a useful purpose; but tight amalgamations or those which are ruled through a system by a despotic board have rarely, we believe, justified their existence—in this country at least. Speaking recently, Mr. Hichens said "success in trade depended upon individual enterprise, energy, and initiative," which were "qualities we possessed in this country in a marked degree, and there could be no substitute for them." We agree heartily with him. In a delightful essay on "The East End" in *London of the Future*, a recently published volume, the Rt. Rev. H. L. Paget, at one time Bishop of Stepney, writes :—"Swifter mechanism may have displaced (it never replaced) the really exquisite products of the weaver's loom. Pride in work, pleasure in work, fellowship in work seemed to leave us. Here, as elsewhere, people no longer cared to live where they worked, or to watch with almost affectionate supervision the processes of an industry which they themselves had built up. We gradually became companies, and when companies come companionship seems to retire; for companies are seldom company." For companies let us read great amalgamations and this passage becomes more true than before. It is the individual firm that makes trade, and it makes most when every member of its body is encouraged to preserve his individuality. But individuality, below a certain grade, is the last thing vast combinations desire, and the consequence is that great numbers of able young men are discontented, and, where they can afford to do so, break away from distasteful service. The inevitable result, as far as we can see, is the gradual accumulation of routineers, men who are content to work to schedule all their days and to climb, if they climb at all, by the Civil Service method of never saddling yourself with authority and never doing anything that is not established by formula.

A question of great interest to all who busy themselves with the human side of factory life is the maximum number of men that make for the best conditions. For a general engineering shop we have heard it put at seven hundred. If that number must be exceeded it is said to be better to start another quite independent factory, under quite independent management. It is certain that the size of a factory must depend upon the personal ability of the manager, and no definite figure can be given; but we are disposed to think that a useful upper limit is one thousand, unless a great deal of repetition work is done, when the figure may be increased. With a thousand hands under him a good works manager can keep in proper touch with the whole of the business; he can know and be known personally to most of the men, and he can encourage that *esprit de corps* which means so much to the happiness of a business. If there are over a thousand hands sub-managers become essential, and the manager-in-chief tends to become the manager of managers rather than the manager of men. There are, fortunately, in England a great many of these relatively small businesses, and though of necessity they attract less public attention than the great firms, it would be a mistake to condemn them all as inefficient. The people who are continually looking to certain American works for inspiration, and who imagine that mass production is the only method of achieving success, forget that there is still vast scope for the more individualistic productions of smaller firms; that—to put a single familiar example—Rolls-Royce or Napiers can hold a market just as well as Ford. But above all they forget that a well-conducted, well-organised, well-managed small factory gives more scope for individuality than a huge factory, and that it does not ask for that terrible degrading monotony of occupation which is the curse of mass production. Mass production may be the only means of producing cheaply, but if it has to be followed we must expect ever-renewed demands for shorter working hours and longer hours of escape from the drudgery of the workshop. If we kill interest in the factory and individuality in the office we cannot be surprised that men think only for themselves and work only for their pockets.

The Economic Operation of Superheater Locomotives.

By F. W. BREWER, A.I. Loco. E.

IN the very nature of things, the locomotive is at best a compromise between certain known advantages and disadvantages. One outstanding fact is that in a general way we cannot utilise the full power of the engine without coming into conflict with what, from some points of view, may be looked upon as scientifically desirable. In order to save coal the engine must be well linked up—the steam must be used expansively. But this linking up always corresponds, by contrast, with a reduction in power. Even if bigger cylinders or more than two cylinders be employed to give a higher total mean effective pressure, the result is the same; the available power with an early cut-off is utilised in only a comparatively limited degree. Steam and coal are saved at the expense of hauling capacity. For the fact remains that heavier loads per engine could be taken if a greater proportion of the potential power were made use of by employing a late cut-off in the cylinders. In the case of goods engines this cut-off may be put at from 60 to 65 per cent., and in the case of express engines at from 50 to 55 per cent.

It is obvious, nevertheless, that scientific application, rather than brute force, is decidedly preferable, if not indeed imperative. A compromise between the two policies is necessary. With an unusually late cut-off the terminal pressure is unduly high, while the resultant heavy blast action tends to lift the fire and to cause the fire-box, tubes, and boiler generally to be worn out more quickly than would otherwise be the case. Neither the steam nor the fuel is used in an efficient manner. Although greater power is developed at the draw-bar, yet the steam is exhausted whilst there are still many units of work left in it. Clearly, then, a very late cut-off is inadvisable. A middle course must be adopted.

So far, we have considered the matter only in relation to saturated steam locomotives. When we come to deal with it in connection with superheater engines we shall find that the conditions are somewhat paradoxical. An especially short cut-off can be, and usually is, employed in such engines; yet it is in those same engines that it is possible to have a fairly late cut-off without necessarily sacrificing the economy. In fact, within reasonable limits, the later the cut-off the higher will be the degree of superheat and the greater will be the relative saving in fuel and water. It must be remembered that for equal quantities of steam and at the same cut-off the work done by the expansion of superheated steam is less than that performed by saturated steam. The disparity increases with the degree of superheat and with the shortening of the cut-off. At first sight it might appear that this loss of work militates against superheating. But it does not, for the reason that, while a slightly greater number of cubic feet of superheated steam, as compared with saturated steam, are required to do a given amount of work, yet the weight of the former is very much less than that of the latter, the result being, in the case of high superheating, a large economy in water, which, in turn, means a smaller total heat expenditure. This is accounted for partly by the vaporisation of all the water particles suspended in the steam when passing through the superheater, and partly by the prevention of condensation in the cylinders. Further, as superheated steam has a greater volume than saturated steam of the same weight, the weight of the former is less than that of the latter for the same cut-off. Since the superheated steam falls in temperature from the point of cut-off, its volume then also decreases, and the actual gain in this respect will be approximately one-half that deduced by theoretical calculations, and it is usually taken to be somewhere about 10 per cent. If we add 30 per cent. as the saving due to the elimination of cylinder condensation—the amount varies, of course—we get a total average water economy of approximately 40 per cent. It will be seen, therefore, that although superheated steam does less work by expansion than saturated steam at the same cut-off, still there is a considerable economy, as the difference between the quantity and weight of steam used—two very different factors—is entirely in favour of the first-named steam. The saving in coal is less than the economy in water, because it is largely governed by the constantly varying conditions incidental to everyday working. Sometimes it is as much as 25 per cent.

Having regard to the fact that the superheater locomotive gives the greatest relative economy when hard pressed, it may be doubted whether expansion should be carried to the limit dictated by theory alone. Tractive efficiency is the first consideration, and it should not be sacrificed for the sake of direct economy purely and simply. Greater power can only be obtained by getting more steam into the cylinders, not by trying to keep it out. From the economic standpoint it does not signify how much the superheated steam locomotive is forced, since its efficiency increases with the increase in superheat, which follows the augmentation in draught due to working the engine, whether temporarily or generally, with a later cut-off. In the case of a saturated steam locomotive just the opposite takes place. As the quantity of fuel consumed per square foot of grate area increases, so the quantity of water evaporated per pound of coal decreases, and although the total quantity of water converted into steam in a given time is greater, it is obtained by a comparatively wasteful expenditure of the heat generated by the fuel. Moreover, the steam becomes wetter and wetter. Assuming a comparison between a superheated steam locomotive and a saturated steam locomotive on a basis of equal weights, and with cylinders and steam pressure alike in both engines, then, by working the superheater engine with a longer cut-off than in the non-superheater, it could not only be made to develop more power, but it could be made to do so on a much smaller consumption of coal and water than would be possible in the case of the "wet" engine for the same ratio of expansion. The usual practice has been to employ larger cylinders in conjunction with reduced boiler pressures, yet it seems to be out of the question, unless the tractive potentialities of the superheater engine be sacrificed, that a comparatively short cut-off can usefully be adopted in such circumstances. A moderately late cut-off would mean a reduction in the direct saving in coal, but the increased consumption of fuel would, in the case of highly superheated steam, be more than offset by the greater work done at the draw-bar, and it would still be relatively low.

For the foregoing reasons it is manifest that superheating should not be restricted to tender engines or to what may be described as main-line work. As a matter of fact, it should be applied to any class or type of locomotives required for heavy duty, including the running of suburban passenger trains and shunting. Engines engaged in the two latter services may not, owing to the comparatively frequent opening and closing of the regulator, give quite so high a steam temperature as those in which a sustained tractive effort is maintained for longer periods; but, even so, they will show economy in coal and water, and will, besides, be much smarter at their work than saturated steam locomotives. The suburban tank engine cannot be linked up much, and the shunting engine, generally speaking, not at all, and these are the very conditions in which superheating may be taken to show to special advantage. The idea has been held that any work of an intermittent character is inimical to superheating, but practice will probably soon prove such an idea to have no real foundation. At any rate, except in cases where the average horse-power output is insignificant, the use of highly superheated steam is strongly advisable, and in proportion as the output per unit is increased, so will the gains from superheating become more and more evident and substantial. In short, any and every condition which makes for inefficiency in the saturated steam locomotive can, in the superheater engine, be turned to good account.

There is another matter affecting road performance that is too frequently overlooked or ignored, and that is the absolute necessity for employing a pyrometer. In many instances the use of this instrument has been abandoned because of its alleged unreliability. But it is without question that a dependable temperature gauge—and there is at least one such on the market—is indispensable to the economic operation of the superheater locomotive. Without it, neither the driver nor the fireman can tell what the degree of superheat is on the road, and consequently the engine cannot consciously be driven and fired in such a way as to produce the best results. It is possible, of course, that the engine may be working economically; but, on the other hand, it is far more likely that the reverse will be the case, and that no superheat of any value is being obtained. If a superheater is worth fitting at all it is worth being used in an effective manner, and it cannot knowingly be so used unless it is possible at all times to ascertain the steam temperature by means of a pyrometer. The pyrometer is just as essential as the pressure gauge, and no superheater locomotive can be said to be intelligently handled if it is absent.

All things considered, it may be doubted whether the strictly theoretical expansion of superheated steam is as desirable as at first sight it seems to be. Such an expansion usually implies a *nominally* powerful engine (*i.e.*, in terms of cylinder diameter, a large piston area being adopted merely in order to allow for the inevitable reduction in cylinder pressure), whereas a longer cut-off in the same engine would not only provide a considerable increase in tractive force, but would also provide it without involving any real loss in economy. On the one hand, the saving is

direct; on the other, it is indirect—or partly direct and partly indirect. In the former case the power of the superheater engine is to all intents and purposes largely suppressed, and is, therefore, in a sense, lost; while in the latter case a much greater proportion of it is advantageously utilised.

Let us, however, carry the argument a little further. As the cut-off is lengthened so the terminal pressure is increased. Although greater power is developed—and developed, *per se*, economically—yet it is clear that the potential tractive force of the engine is far from being sufficiently used up. The question still remains, therefore, of making use of this exhaust by turning it into mechanical energy, perhaps by means of the compound principle, thus augmenting the power in contradistinction to conserving or restricting it. A scientifically early cut-off alone does not seem to meet the case, as it strangles the power at its very source. In these days of costly fuel the problem of getting more power for a given weight of boiler is distinctly important.

Literature.

The Diagnosing of Troubles in Electrical Machinery. By Miles Walker, M.A. London: Longmans, Green and Co., 39, Paternoster-row. Price 32s. net.

Manufacturers and users of electrical machinery alike know how difficult it sometimes is to locate the cause of electrical troubles. Even the most experienced designers and operating engineers are now and then quite unable to understand why electrical machines work imperfectly, and a book such as that now before us has long been required. Professor Miles Walker's wide experience as an electrical designer, and his long association with the Westinghouse Company have enabled him to accumulate a a great amount of valuable information relative to the cause of erratic operation on the part of electrical machines, and in collecting this information together and presenting it in the form of a book he has rendered the electrical profession a useful service. There are, of course, many handbooks which deal with the localisation of simple faults, such as failure of insulation, short circuits and open circuits in armature and other windings; but so far as we know no volume covers the ground so thoroughly as the one under consideration. It does not, however, deal with all the troubles that can occur, for as the author fully recognises and, in fact, explains in the preface, the accidents that can happen and the mistakes that can be made are so diverse and numerous, and the ways in which a defect in a machine can hide itself are so perplexing, that any book on the subject can only deal with a small percentage of the possible troubles and indicate the general methods of attacking problems of the kind.

It is not easy to convey in a few paragraphs an exact idea of the ground which the author covers. Besides dealing with the localisation of simple faults which have been discussed in many other books and articles, Professor Walker pays a great amount of attention to the causes of low efficiency, defects in regulation, the sparking at brushes, the want of balance in rotors, overheating and miscellaneous troubles. Although much has been written upon the commutation of direct-current machines, the section of the book which deals with this important matter is a highly instructive one, and is written, like most of the other sections, on thoroughly practical lines. It is obviously the outcome of a very wide practical experience. The theory of commutation and the conditions which must be fulfilled to enable a machine to run sparklessly are very thoroughly discussed. Practically every conceivable defect which is liable to cause a machine to spark is carefully considered in detail, and various interesting matters which have come under the author's notice are dealt with. Dealing with soft commutator copper, for example, Professor Walker says: "One remarkable thing about the phenomenon is that it invariably disappears on its own accord when the machine is kept in service for a number of months. All sorts of different carbon brushes may be tried; all sorts of adjustments of commutating holes and brush positions may be tried, each one of which is alleged to produce some improvement. After working through every kind of carbon brush and making every likely kind of adjustment, if in about six months' time the experimenter works round to the same brush and the same electrical adjustment as he had to begin with, he will generally find that the soft copper has cured itself."

In writing his book Professor Walker has kept well in mind the requirements of the "outdoor" engineer, who has to locate the causes of troubles which have developed in dynamos, motors and converters in operation in various kinds of works. A useful chapter bearing upon this work gives descriptions of testing sets for the outdoor engineer's use. Various tests that may be applied to detect the breakdown of insulation are also described. The chapter on miscellaneous troubles, which deals, among other things, with the balancing of high-speed rotors is another section of the book which will, we think, prove of considerable service to practical men. In this chapter useful hints are given in respect to locating the cause of eddy currents in journals and bearings, and the cause of noise and other objectional defects, such as the magnetisation of generator shafts, &c. The most theoretical chapter is that which is devoted to vector diagrams, but it is not by any means an uninteresting or unimportant one. The whole book is highly instructive, and it cannot fail to acquire popularity among desjgners, erectors, shiftmen, and testing engineers.

Fifty Years of Electricity. By Dr. J. A. Fleming. London: The Wireless Press, 12 and 13, Henrietta-street, Strand, W.C. 2. Price 30s. net.

Those who are interested in the history of electrical engineering will find this book entertaining. Apart altogether from the author's close association with the electrical industry during the past fifty years, and his distinguished work in the capacity of an experimentalist and inventor, he possesses the art of writing upon electrical engineering in a clear and concise manner, and the book is interesting from beginning to end. Although the volume has apparently been written mainly to enlighten the general public and not for the benefit of technical people, there is little doubt, we think, that it will be read and appreciated by a good many engineers. It may possibly assist junior engineering students in obtaining a preliminary acquaintance with the outlines of a subject they will study in greater detail in other books. The amount of electrical knowledge which the reader is supposed to possess can be gauged pretty accurately from the author's definition of the dynamo, which reads as follows:—"A dynamo, in scientific language, is an energy-transforming device. A certain amount of power is applied to the armature shatt to keep it in rotation, and the machine gives a certain current at a certain voltage at its brush terminals. The electric power output is reckoned in units called kilowatts (KW) or by the product of the constant electric pressure reckoned in volts and the output in current in ampères, divided by 1000." From beginning to end the volume is quite elementary, and from the point of view of qualified engineers its value lies almost entirely in the historical information. There are many excellent illustrations of early electrical devices, such, for instance, as Faraday's electro-magnet with which he made his greatest discoveries, Pixii's dynamo, Edison's early electric lamps, and so forth. One of the chapters deals at considerable length with the early electric supply stations, such as the Deptford and Grosvenor Gallery stations. Here there are some good illustrations showing alternators and engines which were employed in the early days of electric lighting. There are also pictures of several modern stations, including the Underground Railway Company's station at Lots-road, and, needless to say, the difference between this station and the old Deptford and Grosvenor Gallery stations is very marked. The book also deals with telegraph and telephones from 1870–1920, dynamos, alternators, transformers and motors from 1870 to 1920, electric lamps and electric lighting in the last fifty years, electric heating, cooking and furnaces, electric theory and measurements and wireless telegraphy and telephony. To the latter subjects a good deal of space is devoted, and much instructive information is given in an easily understood form.

Unemployment: The Cause and a Remedy. By Arthur Kitson. London: Cecil Palmer. 1921. Price 5s. net.

In this small volume there are collected six letters which Mr. Arthur Kitson wrote to *The Times* "Trade Supplement." The author's thesis is that unemployment is caused by excess of production and that production is in excess because people have not enough money to buy all the commodities. They are short of money, he says, because the bankers let money out at usury (interest) and because they control the world. His cure for all our troubles appears to be the issue of Treasury Notes and Treasury Bonds up to, if necessary, the full credit of the nation. There are, we believe, a good many weak spots in his arguments and a good many fallacies; but we leave them to the criticism of the experts in finance, the economics of exchange, and international credit. One thing we would say, however. It is this. The value of all goods can be brought down to the number of hours of labour expended in their production. Not all labour is of the same value, and the man whose labour is worth twice that of another is called upon to give only half as much of it. Were we to adopt Mr. Kitson's plan the only effect would be to alter the nominal value of an hour's work without changing by a particle its real value, and there would be no more rapid consumption of commodities than under the present system. We can get richer only by making every hour of labour worth more; in other words, if a fitter's present labour is worth one loaf of bread, he could make it worth two loaves by working twice as hard, and the consumption of bread could then be doubled. That is the elemental principle of labour of all kinds, and we do not believe it can be avoided by any form of financial legerdemain.

SHORT NOTICES.

The Geology and Mineral Resources of the Serb-Croat-Slovene State, being the Report of the Geologist Attached to the British Economic Mission to Serbia. By D. A. Wray, B.Sc., F.G.S. Published by the Department of Overseas Trade and obtainable from his Majesty's Stationery Office. Price 3s. 6d.—The kingdom of the Serb, Croats, and Slovenes is not well known to Englishmen, and any information about it that may lead to further openings for the exercise, science, or the development of trade are welcome. The report before us is the only work on the subject in the English language, and that it should prove of considerable value to mining engineers and institutions, as well as to manufacturers of mining machinery and equipment, cannot be doubted, for it is full of information which, if it has the effect of being scrappy and not always based on first-hand knowledge, is yet sufficient to show the great geological value and interest of the country. The sections dealing with the coal and iron ore resources are more exhaustive than most of the others, and furnish much useful data in regard to analyses, output, estimated reserves, &c. Attached to the report are three appendices containing a bibliography of the principal mining publications on Yugoslavia, a glossary of the principal Serbian mining terms, and a copy of the mining laws of the country.

Earthwork in Railway Engineering. By John W. F. Gardner. London: Constable and Co. 1921. 15s. net.—A book dealing essentially with British practice and largely based on the author's experience as resident engineer on the Caledonian Railway, but in which occasional reference is made to the conditions prevalent in less developed countries. It opens with the investigations necessary before a decision is made as to the exact route of a railway, and then goes on to consider the actual work of constructing embankments and cuttings. The plant required and the methods generally adopted to overcome difficulties are described in detail. A specially useful chapter is that devoted to slips in earthwork, in which there are several accounts of the means employed in specific instances to combat slips. The work, which is well illustrated with line drawings, is concluded by a section on the conditions affecting the cost of earthworks and some hints on the drafting of specifications.

Blue Printing and Modern Plan Copying. By B. J. Hall. London: Sir Isaac Pitman and Sons. 1921. 6s. net.—The subject of blue printing and its allied processes might, at first sight, appear to be uninteresting and circumscribed; but in this book Mr. Hall, by drawing on his wide experience, has made it quite attractive. He does not, for instance, confine himself to the immediate subject, but points out how photo-printing can be best employed in securing orders. Descriptions are given of all the principal printing machines and of the several processes for which they can be used, while there is a large section devoted to the gelatine, true to scale process, and another to the photostat. It is a book well worthy of consideration by any chief draughtsman.

BOOKS RECEIVED.

Complete Income Tax Chart. By C. H. Tolley. London: C. H. Tolley, 4, Great Winchester-street, E.C. 2. Price 2s. 6d. net (post free, 2s. 8d.).

Metric System for Engineers. By C. B. Clapham. London: Chapman and Hall, Limited, 11, Henrietta-street, W.C. 2. Price 12s. 6d. net.

Work of the Royal Engineers in the European War, 1914–1919: Water Supply (France). Chatham: Institution of Royal Engineers. Price 25s. net.

Mechanics: A Text-book for Engineers. By J. E. Boyd. London: McGraw-Hill Publishing Company, Limited, 6 and 8, Bouverie-street, E.C. 4. Price 21s. net.

Chemical Warfare. By A. A. Fries and C. J. West. London: McGraw-Hill Publishing Company, Limited, 6 and 8, Bouverie-street, E.C. 4. Price 21s. net.

Miscellaneous Implements Exhibited at the Derby Show, 1921. London: Royal Agricultural Society of England, 16, Bedford-square, London, W.C. 1. Price 1s. net.

"Transactions" of the Institution of Naval Architects. Volume LXIII. Edited by R. W. Dana, O.B.E. London: The Institution of Naval Architects, 5, Adelphi-terrace, W.C. 2.

Italian Technical Words and Phrases. An English, Italian and Italian-English dictionary. By E. F. Paventa. London: E. Marlborough and Co., Old Bailey, E.C. 4. Price 6s. net.

Analytical Geometry, with Introductory Chapter on the Calculus. By C. I. Palmer and W. C. Krathwohl. London: McGraw-Hill Book Company, 6 and 8, Bouverie-street, E.C. 4. Price 15s. net.

Hydro-electric Engineering: Volume I., Civil and Mechanical. Editor, A. H. Gibson. Contributor, H. D. Cook. London: Blackie and Son, Limited, 50, Old Bailey, E.C. 4. Price 25s. net.

Fuel and Refractory Materials. By A. Humboldt Sexton. New edition revised and enlarged by W. B. Davidson. London: Blackie and Son, Limited, 50, Old Bailey, E.C. 4. Price 12s. 6d. net.

The Lancashire and Cheshire Coal Research Association: The Determination of the Calorific Value of Coal. By F. S. Sinnatt and Miss May B. Craven. Manchester: Laboratory, College of Technology. Price 1s. net.

The Induction Motor and Other Alternating-current Motors: Their Theory and Principles of Design. By B. A. Behrend. Second edition. London: McGraw-Hill Book Company, 6 and 8, Bouverie-street, E.C. 4. Price 24s. net.

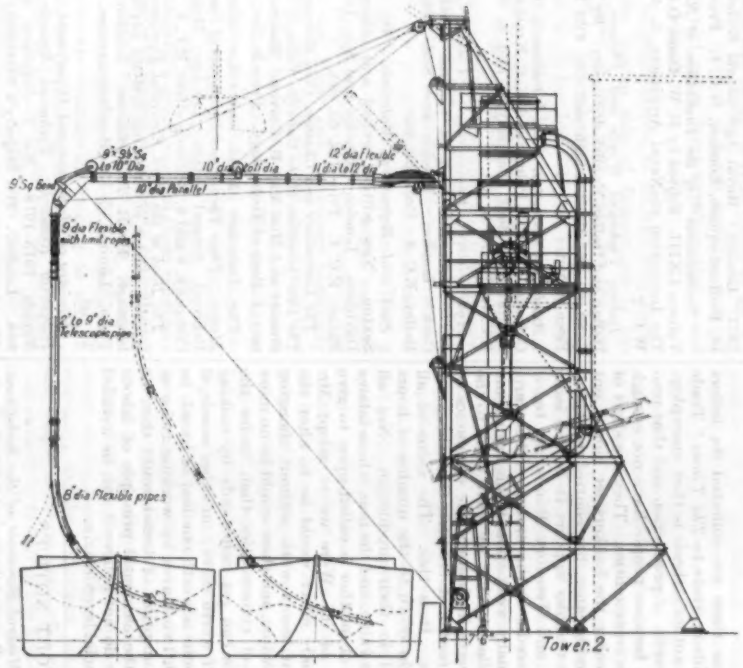
The Book of the Ford Electrical Equipment. The Ford ignition starter and lighting systems explained in simple language. By R. T. Nicholson. London: The Temple Press, Limited, 7–15, Rosebery-avenue, E.C. 1. Price 3s. net.

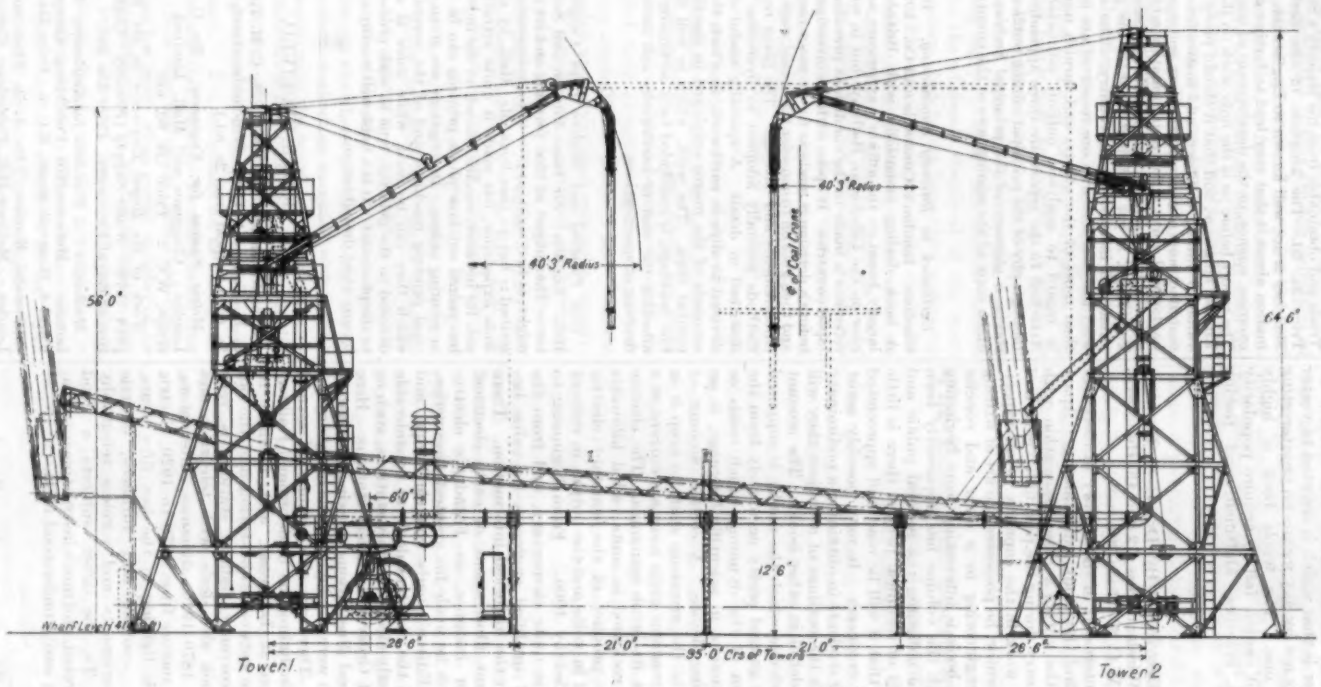
Ministry of Munitions and Department of Scientific and Industrial Research: Technical Records of Explosives Supply, 1915–1918: No. 3—Sulphuric Acid Concentration. London: His Majesty's Stationery Office. Price 12s. net.

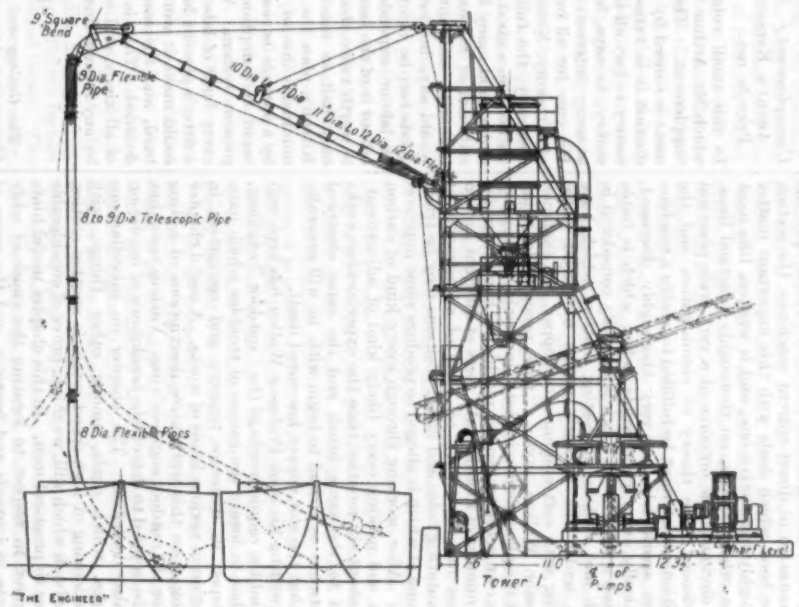
PNEUMATIC COAL-HANDLING PLANT AT BANKSIDE ELECTRIC GENERATING STATION, LONDON

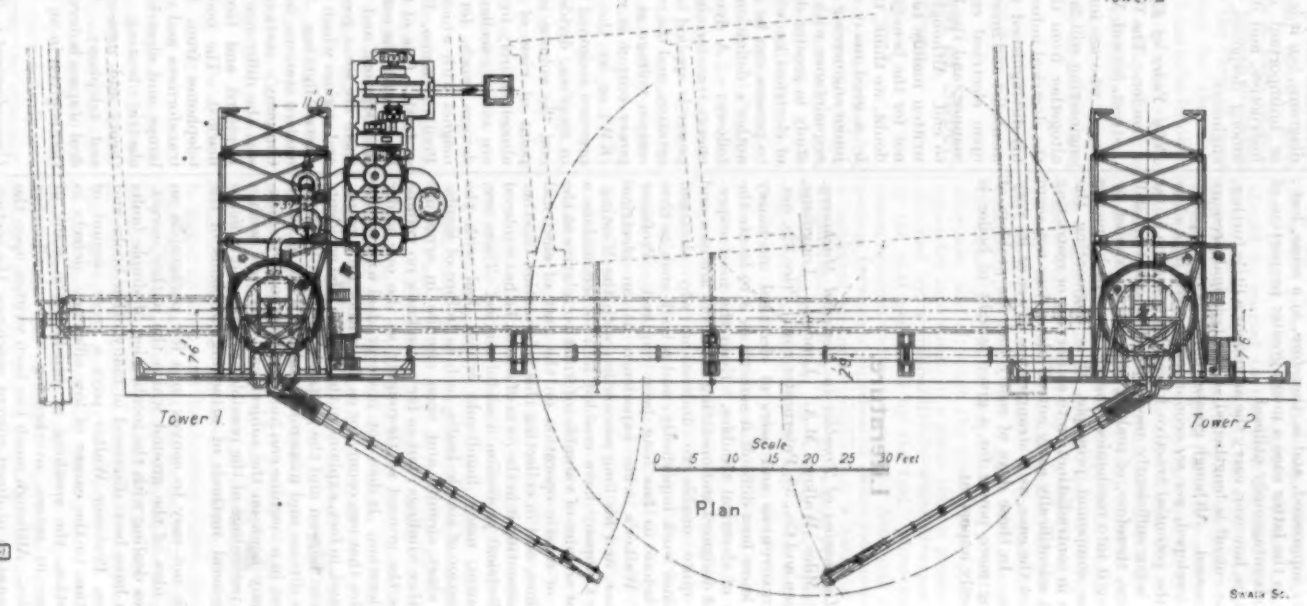
HENRY SIMON, LIMITED, MANCHESTER, ENGINEERS

(*For description see page 601*)









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THE pneumatic handling of coal, which is a more or less new idea, is, of course, a development of the pneumatic method of grain-handling, first introduced at the London docks about thirty years ago. Long experience with these plants, in connection with unloading grain, has led to modifications being made to enable the equipments to deal with coal in the form of nuts or slack. One great advantage of the system is that it is very flexible. The pipe through which the coal passes may be run overhead, across buildings, roads or railways, or if necessary underground, and may be provided with a system of branches commanding a wide area. Conveying pipes can, moreover, be fitted with swivelling or universal joints with

FIG. 89—PNEUMATIC COAL-HANDLING PLANT

telescopic and flexible sections, and need not be very large, as an 8in. pipe will carry up to 60 tons of coal per hour.

A pneumatic coal-handling plant has recently been installed by Henry Simon, Limited, of Manchester, at the Bankside Works of the City of London Electric Lighting Company, and through the courtesy of Mr. Frank Bailey, the chief engineer, we are able to illustrate the equipment. On the wharf a tower 65ft. high and with a series of platforms is erected, as shown in Fig. 89 and in the drawing on page 600. On the top platform is a cylindrical bin, 15ft. deep, 6ft. 3in. in diameter, and having a hopper-shaped bottom. From this receiver a pipe 12in. in diameter extends outwards over the water, and, as shown in the drawing on page 600, the outer end is stayed by adjustable ropes from the top of the tower, so as to form a movable arm or boom with a flexible joint. To the outer end of the boom a 9in. flexible pipe with an intermediate telescopic length is connected, and this pipe extends down into the hold of the barge or collier in the usual manner, the lower end of the pipe being provided with a special nozzle, which is pushed into the coal. The receiver is divided into three parts, and the middle section is connected by means of a 12in. pipe with the vacuum pumps shown in Fig. 90, and which exhaust the air from the receiver and cause the coal to be drawn up from the barge on to a "tipper seal" below the receiver. The latter contains a series of ninety-nine vertical fabric pipes, known as filtering tubes, through which the dust-laden air has to pass, and in which the coal dust is collected. At intervals these pipes are shaken so as to cause the coal dust that has accumulated in them to fall into the hopper. This part of the plant corresponds to the dust bag on a vacuum cleaner, but the air is drawn, in the case under consideration, through the fabric on the filtering tubes into the vacuum chamber, the object, of course, being to avoid air containing dirt reaching the suction pumps. The upper ends of the filtering tubes are secured to a horizontal diaphragm, and are sealed, whilst the lower ends are open and are secured to another diaphragm, which, by means of a lever, is shaken up and down at intervals so as to dislodge any accumulation of coal dust within the tubes.

The tipper seal beneath the receiver is a double-compartment rocking air-tight box—see Fig. 91—with a vertical hinged partition. In the drawing A and B are the two compartments which are brought

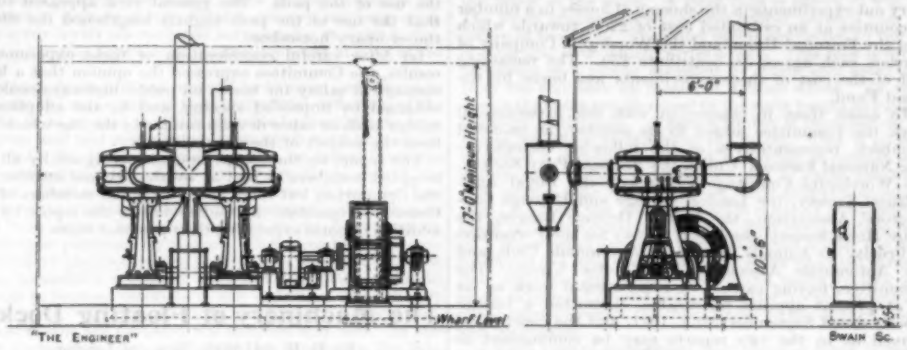


FIG. 90—VACUUM PUMPS FOR COAL-HANDLING PLANT

into communication alternately with the mouth C of the receiver above. When each pocket is thus engaged and therefore under vacuum, its hinged door D is held closed by the pressure of the atmosphere. Simultaneously, the other pocket has been swung far enough over to allow air to be admitted, as shown on the right of Fig. 91, and the hinged door of this compartment therefore opens and the contents are discharged. It will be seen that in the upper casting E there are air ports F, which exhaust the air from the pockets before the coal is admitted to them, the object being to prevent the inrush of air carrying the coal over into the dust collector. Suppose the coal from the receiver to have filled one compartment, the tipper seal is then tilted by means of a belt-driven crank and yoke, and as it moves over the lower door opens and the contents are discharged into a hopper beneath the floor. Meantime, coal from the hopper has filled the other compartment, and the tipper seal is again tilted, the operation being repeated at predetermined intervals as long as the plant remains at work. From the hopper the coal drops through a 12in. opening on to an endless belt,

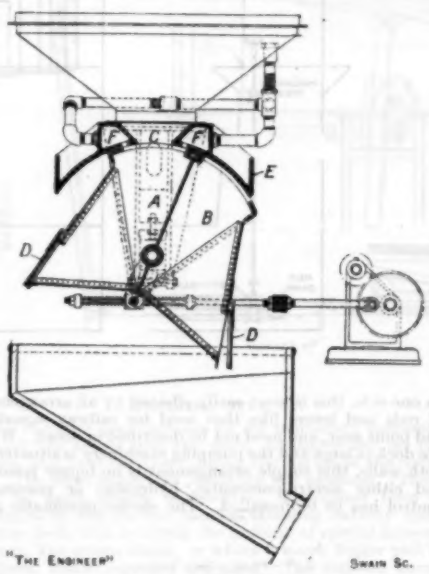


FIG. 91—TIPPER SEAL

which conveys and discharges it into a storage bunker or into coal trucks. The nozzle through which the coal enters the pipe is moved about so as to keep it in contact with the coal and to prevent air only from being drawn up into the receiver. To the nozzle a door is fitted so that in the event of the nozzle becoming blocked, it can easily be cleared. The nozzle box is about 3ft. long, 13in. wide and 8in. deep. All the parts of the equipment are so proportioned, that once the coal has passed through the nozzle there is no fear of it jamming elsewhere. The vacuum, which amounts to nearly 12in., is maintained by a double-acting air suction pump, having cylinders 49in. diameter and a 16in. stroke. There are two of these plants at the Bankside station, one serving for each boiler-house, and each plant can deal with 60 tons of coal per hour.

Although calculation may make this method of handling coal appear somewhat extravagant, the system offers the advantage of enabling the coal to be unloaded from the barges with great rapidity. Even if the cost per ton of coal dealt with in this way exceeds the cost of handling by grabs, the speed of operation and other advantages are claimed to well outweigh this fact. It is well known that the maximum height to which an ordinary hydraulic suction pump can deliver water is about 27ft., and it may not be evident to all how it is that coal, which is heavier than water, can be sucked up to nearly twice that height. The fact is, however, that the work is not entirely done by suction. A great quantity of air is, of course, drawn up in addition to the coal, and as air will rapidly fill a space occupied by a vacuum, the speed is sufficient partly to drag and partly to force the coal upwards.

Some important extensions are at present being carried out at the Bankside station, but the work is scarcely far enough advanced to enable us to publish a description. The Oerlikon Company is installing a new 10,000-kilowatt generating unit, whilst Babcock and Wilcox are putting in five cross marine shell-cased water-tube boilers. Each boiler has an integral superheater, superimposed economiser, chain-grate mechanical stoker, a separate steel chimney, and a self-contained induced draught plant. Incidentally, it may be mentioned that for some little time past oil fuel has been used for firing some of the boilers in this station. Scarab burners, with a gravity feed, are employed. The oil is pumped into the storage tanks by a Feuerheerd's motor-driven pump, which has been found to work very successfully. Additional oil storage tanks, of pressed mild steel plates with outside joints, are being installed by Brown, Lennox and Co., of Millwall. Reyrolle and Co. are supplying some new switchgear, and Mirrlees-Watson the condensing plant.

*No. XVII. appeared November 25th.

Slippery Road Surfaces.

A REPORT on slippery road surfaces has recently been made to the Minister of Transport by Sir Henry Maybury Director-General of Roads. In it Sir Henry points out that complaints having been received from time to time from various parts of the country concerning the slippery nature of road surfaces under modern methods of construction, and their consequent unsuitability for horse traffic, the Minister of Transport towards the end of 1919 asked the President of the County Surveyors' Society to nominate an Expert Committee, "to consider the steps which it is advisable to take to make the impervious surface of the roads of the country less slippery for horses, and to carry out such experiments and investigations in connection therewith as may be necessary." The following Committee was accordingly set up:—Mr. A. Dryland, M. Inst. C.E., county surveyor of Surrey, since appointed county engineer and surveyor of Middlesex; Mr. C. F. Gettings, M. Inst. C.E., county surveyor of Worcestershire; and Mr. A. J. Lyddon, A.M. Inst. C.E., county surveyor of the North Riding of Yorkshire, since appointed Divisional Road Engineer in the Ministry of Transport.

The Committee in the first place submitted a questionnaire to all county surveyors in England and Wales, asking for information as to the nature and period of the complaints, their incidence in each county, and the particular road surfaces to which the complaints applied. After considering the replies received and also consulting certain representatives of the Worshipful Company of Farriers, the Farmers' Union and the Royal Agricultural Society, the Committee in April, 1920, submitted an interim report, setting out the results of its preliminary investigations. In it they stated (*a*) that a digest of the answers to the questionnaire addressed to county surveyors indicated that the complaints were far more common in some counties than in others, and generally arose in the more rural areas; (*b*) that they came mainly from farmers, to a lesser degree from riders and drivers of light horses, but not from general hauliers; and, further, (*c*) that they were generally seasonal in their incidence, arising chiefly in frosty weather, but also on damp, rather than wet days, and only occasionally in dry weather unless at the end of a prolonged period of drought, when the road surface had become highly polished. The replies also tended to support the view that asphalt roads were less slippery than either tar-macadam, pitch-grouted or tarred water-bound roads. An analysis of the methods of surface treatment also suggested that slag dust was the covering material which produced the most slippery surface, and that crushed shingle, fine gravel or coarse sand, or in some cases granite chippings, afforded a better grip for horse traffic.

The Committee therefore suggested in its report that it should be authorised to carry out at least three classes of experiments:—

(i) On methods of roughening the finished surface of tar-macadam.

(ii) On the construction of bitumen grouted roads.

(iii) On the construction of thin bitumen carpets on tar-macadam roads.

It also asked for authority to carry out experiments in the shoeing of horses in order to test the utility of special shoeing devices on different types of road surfaces.

Arrangements were accordingly made to put down experimental sections of roads in three counties—Worcestershire, Hampshire, and the North Riding of Yorkshire—at an estimated cost of about £8000. The county councils concerned agreed to contribute half the cost of the experiments. At the same time it was decided to carry out experiments in the shoeing of horses in a number of counties at an estimated cost of £200, towards which sum the Farmers' Union and the Worshipful Company of Farriers each agreed to contribute £50. The remaining half of the cost of these experiments was borne by the Road Fund.

To assist them in connection with this experimental work the Committee added to its number, as co-opted members, representatives of the following societies:—The National Farmers' Union, the National Pony Society, the Worshipful Company of Farriers, the Royal Agricultural Society, the London Cartage and Haulage Contractors' Association, the Equine Defence League, the Shire Horse Society, the Royal Society for the Prevention of Cruelty to Animals, the Royal Automobile Club, and the Automobile Association and Motor Union. The Committee, having carried its experimental work as far as at present appears practicable, submitted a further report, dated September 22nd, 1921, and the conclusions arrived at in the two reports may be summarised as follows:—

(*a*) *Methods of Road Construction.*—After exhaustive inquiries and experiments, the Committee has failed to satisfy itself that there is any accepted method of road construction, or of road surface treatment, which, while capable of withstanding the effects of modern traffic, does not, under certain climatic conditions, become slippery for horses. There is practical unanimity among road engineers that road surfaces which carry any considerable mechanically propelled traffic must of necessity be waterproof if they are to endure, as the permeation of water leads to rapid deterioration, but the close texture required for a waterproof surface cannot apparently be dissociated from an occasional liability to slipperiness. The experimental road sections put in hand during 1920–21 were planned with a view to discovering whether those stretches of road, when provided with an asphaltic or bituminous surface, were, in fact, less slippery than when constructed of tar-macadam; and if so, whether the advantages gained were sufficient to justify the cost of the adoption of some such treatment.

The results of the experiments were briefly as follows:—Two stretches of road, one in Worcestershire and the other in Yorkshire, were grouted with a proprietary material in which bitumen and tar were incorporated. The surface was found to become polished under traffic and to show a tendency to slipperiness, though on the Yorkshire section horses did not show the same liability to slip as on an adjacent tarred section of road. Further, on the grounds of cost and comparative slowness in laying this process, it is not likely to be extensively adopted as a means of ameliorating slippery road conditions. Two sections of another road in Worcestershire were laid with specially prepared asphalt carpets. There, again, complaints of slipperiness were received when the surface was damp, and, owing to its cost, it is improbable that that material will be used on other than very heavily trafficked roads. A surface treatment with cement grout was tried on two other sections of roads. It appeared to be fairly effective on the section with comparatively light traffic, especially when fine gravel was placed on the grouting; but in the case of the second road, over which there was heavy mechanical traffic, the greater portion of the material disappeared within forty-eight hours of the opening of the section.

(*b*) The Committee considered the practicability of leaving the sides of a road in water-bound macadam and confining the treatment with waterproofing material to the central portion of the road, but it found a great preponderance of expert opinion to the effect that that course was only possible within very narrow limits and where motor traffic was comparatively light. In several cases where this procedure has been adopted, it has been found impossible to maintain the sides of the road with any degree of satisfaction or economy.

(*c*) *Surface Dressings.*—As an immediate means of alleviating slipperiness of existing surfaces, the Committee advises the application of coarse sand, sharp grit, crushed gravel or shingle, or granite chippings not exceeding ¼in. gauge to such sections of roads as may from time to time become unduly slippery. Sections which are particularly troublesome during early morning frosts should be gritted overnight if weather conditions indicate the probability of frost. The Committee points out, however, that these surface dressings eventually form mud or dust. Their application should, therefore, be carried out with discretion, and only to the extent necessary to make the roads reasonably safe for horses. Applications of tar to existing surfaces should be limited to those actually necessary for the purpose of waterproofing and binding, and should not be repeated unless and until the conditions require it. An ample allowance of grit should be used after each application of tar so as to incorporate as much grit as possible with the tar.

(*d*) *Shoeing Experiments.*—The shoeing experiments commenced in October, 1920, and continued during the winter and spring. About thirty kinds of shoes and attachments were submitted for examination. Many of these devices were not regarded as practicable, but there were a few which, in the opinion of the Committee, deserved closer investigation. The attachment selected for experiment, as the most useful and the least costly, was an improvement on the flexible bridge pad which obtained a prize in the open competition initiated in 1914 by the Roads Improvement Association. Three hundred and twenty-six sets of the pads were issued free of cost to farmers and other horse owners in twenty-two different counties. The trials were carried out with various classes of horses on all kinds of road surfaces, including asphalt, bitumen, tar-macadam, tarred and ordinary macadam surfaces.

Unfortunately the majority of the horse owners to whom the pads were sent for experiment did not show as much interest as might reasonably have been expected if the evil of slipperiness were, in fact, severely felt, and only 134 reports were received on their use. In 103 of these—77 per cent.—a definite opinion was expressed that the pads were effective, to a greater or less degree, in preventing slipping on road surfaces. Some owners added the qualification that they were not suitable for horses working on the land and only occasionally using the roads. In several cases, however, the reports were extremely favourable, and the writers stated their intention of continuing the use of the pads. The general view appeared to be that the use of the pads slightly lengthened the life of the ordinary horseshoes.

(*e*) After careful consideration of these experimental results, the Committee expressed the opinion that a large measure of safety for horses on public highways could be obtained by improved shoeing, and by the adoption of rubber pads or other devices similar to the one which had been the subject of their experiments.

The report on these experiments was signed by all the co-opted members as well as by the original members of the Committee, but three of the co-opted members of the Committee qualified their adherence to the report by the addition of notes expressing their personal views.

The Machinery of Floating Docks.*

By E. H. SALMON, D.Sc., of London.

(*Concluded from page 576.*)

CONTROL.

As has been pointed out, the problem of pumping a floating dock differs from that of a graving dock and similar cases, in that balance of the system has to be maintained while the pumping is proceeding; that is to say, it must be within the power of the dock master at any moment to allow or prevent water entering or leaving any particular compartment. As has been seen, this is effected by means of a valve governing each compartment pipe. In order that one man may control the whole operation it is necessary that the movement of the valves be regulated from one control station, usually called the valve-house. In small docks, where the pumping machinery is entirely on one side, this is most easily effected by an arrangement of rods and levers like that used for railway signalling and point gear, and need not be described in detail. When the dock is large and the pumping machinery is situated on both walls, this simple arrangement is no longer possible, and either electro-pneumatic, hydraulic, or pneumatic control has to be installed. The electro-pneumatic gear

FIG. 11.—*Diagram of Electro-Pneumatic Valve Control Gear.*

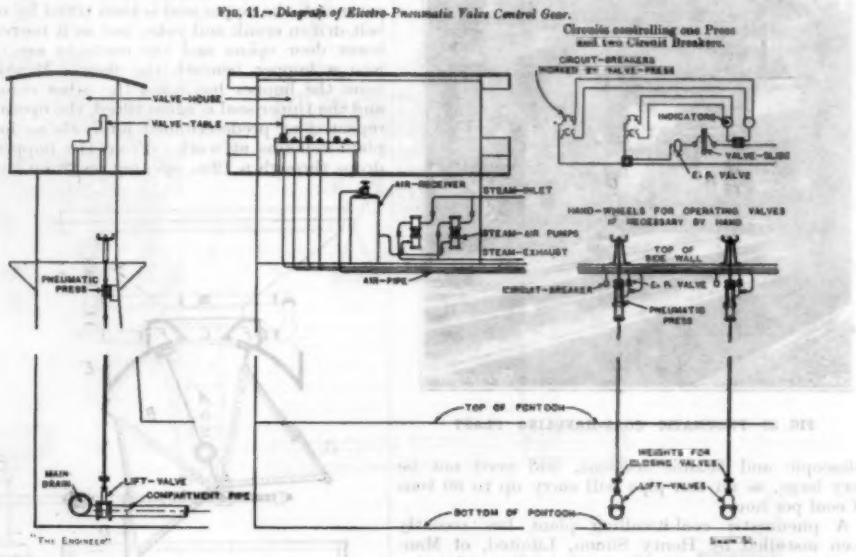
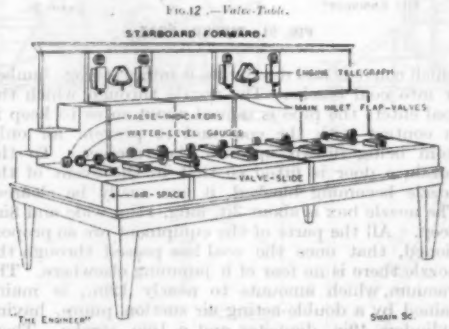


FIG. 12.—*Valve-Table.*



is a development of the Westinghouse electro-pneumatic railway signal gear, and, as installed by that company, has worked very successfully. It is illustrated diagrammatically in Fig. 11. The valve rod is lifted by a pneumatic press, which is supplied with compressed air at about 5 or 6 atmospheres from an air receiver. The compressed air is supplied by Westinghouse pumps of suitable size or otherwise as may be convenient. The connection between the valve-house and the press is electric. Contact is made in the valve-house by means of a suitable valve slide or switch, which results in the excitation of a small electro-magnet near the press. This magnet lifts a valve called the E.P. valve. As a result, the exhaust of the main press is closed, the inlet opened, and the air passes into the press, lifting the valve rod and opening the compartment valve. The area of the inlet valve is so proportioned that a suitable speed of lift is attained, usually about 15 sec. The press remains in this condition until contact is broken in the valve-house, when the exhaust opens and the compartment valve is shut by a series of weights attached to the valve rod, which carry the valve rod and gates down to the closed position. The position of the valves, whether opened or closed, is indicated in the valve-house on small dials. These indicators are electrically operated, the movement of the press making and breaking contact by means of suitable contact breakers.

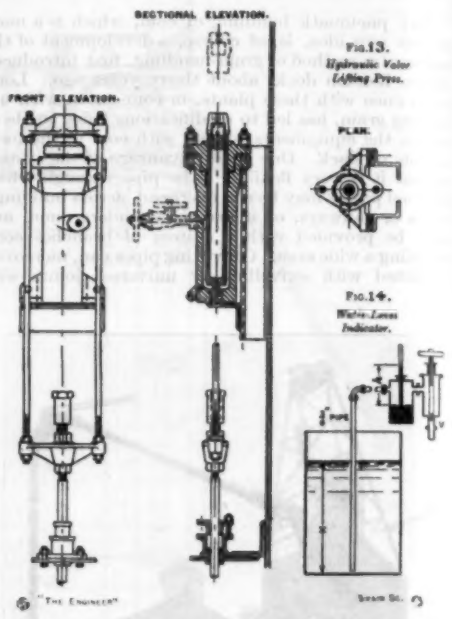


FIG. 13. *Hydraulic Valve Lifting Press.*

FIG. 14. *Water-Level Indicator.*

The current used is supplied by secondary batteries or otherwise as convenient, at a pressure of about 10 or 12 volts. The air receiver is made of such capacity that all the valves can be lifted and closed three times in one minute without reducing the pressure too much for successful operation. Wrought iron steam piping is used for the air mains. Should the compressed air or electricity fail during a lift, it might become necessary to operate the valves by hand. For this purpose a prolongation of the valve rod is carried above the deck and through a nut operated by a hand wheel.

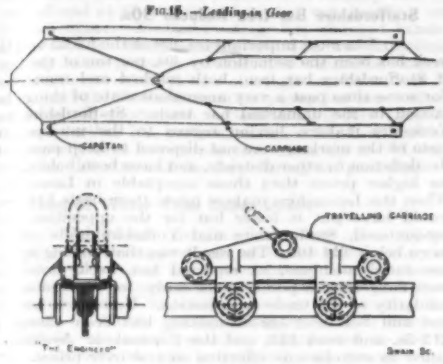
When the electro-pneumatic system of valve operation is employed the controls are arranged in the valve-house on a valve table. This table is made in the shape of a large model of the dock and each compartment is indicated. Fig. 12 shows one quarter of such a table. On the space representing each compartment is placed the valve slide or switch—shown in Fig. 12 as a rectangular box with a projecting handle—the indicator showing whether the valve is open or shut, and a gauge showing the height of water in each compartment. The dock master has thus the whole condition of affairs at every moment under his eye and can make the necessary regulations with ease.

The hydraulic and pneumatic systems are very similar in operation. The valve is lifted by a press as in the case of the electro-pneumatic system; the type used for the hydraulic system is shown in Fig. 13. In the valve-house the valve control lever operates a two-way cock by means of which the supply pipe to the press is connected to pressure or exhaust as desired, causing the press to rise or descend as required. The details are simple and work

* The Institution of Mechanical Engineers.—Abstract.

well. In the hydraulic transmission the necessary accumulator may be of the ordinary weighted type, or an air bottle half full of air works quite satisfactorily. The details of the pneumatic system are similar; the underlying idea is, in fact, exactly the same as the tubular pneumatic action common in organ building. This type was successfully installed by Swan, Hunter and Wigham

FIG. 15.—*Leading-in Gear*



Richardson, Limited, in the Schiedam Dock. On the valve table will be found also the engine telegraphs in the case of steam-driven docks, and the motor controls in electric drives. Telephones to the engine-rooms are likewise provided.

A good deal of valve regulation may be avoided by adjusting the revolutions of the main pumping engines. If one end of the dock tends to come up faster than the other, the engines at that end are slowed down and those at the lagging end quickened up.

The water level indicators mentioned above are usually pneumatic. At the bottom of each compartment a cast iron bell or inverted cup is provided, connected to the valve-house by a length of composition pipe. This pipe is joined on to a T-piece in the valve-house, one leg of which leads to a compressed air reservoir. This branch has in it a valve, which, when opened, allows air to pass through the pipe and to bubble out of the bell at the bottom of the compartment. If the valve be now closed the bubbling will cease when the pressure in the pipe and bell is equal to the head of water in the compartment, and further, as the head increases or diminishes, so the pressure of the air in the pipe will rise and fall. To the third leg of the T-piece, therefore, a pressure gauge is connected, graduated in feet and inches of height of water in the dock compartment. It is evident that this gauge will read the height of water in the dock compartments. As already mentioned, it is placed on the valve table in its appropriate compartment.

A variant of this arrangement is shown diagrammatically in Fig. 14. Compressed air enters through the valve V, which is capable of nice adjustment. It bubbles out of the tube shown at the bottom of the tank. The pressure necessary is regulated by the head of water H, and is measured by a mercury column in the valve-house, whose height *h* can be read on a suitably graduated scale. These pneumatic water level indicators work reasonably well in practice, but are somewhat delicate in constitution. In a large dock there may be from 5 to 6 miles of the small-bore tubing leading to the valve-house, the whole of which needs to be absolutely air-tight and leaks are very difficult to locate. Attempts have been made, therefore, at various times to use electrical means to replace the pneumatic systems. As a rule, the principle adopted is to cause variations in the water level in the compartments to increase or decrease the resistance of a wiring system. Electrical devices in the valve-house measure the altered resistance, and hence the head in the compartment. In other systems the movements of a float on the surface of the water are electrically transmitted to the valve-house and there registered on a dial.

The valve-house contains, in addition, apparatus for showing the amount of tip on the dock. The simplest form is an ordinary pendulum or plumb bob, or, better still, two, so arranged that one shows the amount of tip athwartships (list) and the other the longitudinal tip (trim). Continental makers usually fit indicators in the form of a cross section or longitudinal view of the dock, as the case may be, mounted on a card and swinging on a horizontal axis, with a pointer passing over a dial. The pointer indicates the number of degrees of tip. In this country two long sensitive spirit levels are mounted horizontally at right angles, thus indicating to the dock master any want of level of the dock.

In long docks it is not unusual to fit some instrument to indicate the magnitude of the longitudinal deflection of the dock. It is evident that it is possible to keep the dock on an even keel and nevertheless to pump it very irregularly. For example, too much water might be taken from the end compartments and too little from those nearer the centre. Now a lifting power of well over 50 tons per foot run is quite common in large docks, and it will be obvious that very severe bending moments might be set up by injudicious pumping regulation. These bending moments would show themselves as a deflection of the dock, and it is often considered necessary that the dock master should be able to form an estimate of this deflection while the lift is going on. Of the methods employed to effect this, optical means are probably the simplest and best. In the most elementary form a telescope is clamped on the side of the valve-house. At the end of the side wall a vertical post is erected in a line with the axis of the telescope. The top half of this post is painted white and the bottom red, the line of division representing a critical deflection beyond which it is not desirable to go. Provided, therefore, the post appears white through the telescope, the dock master knows that he is safe.

FIG. 16

Mechanical Side-Shore

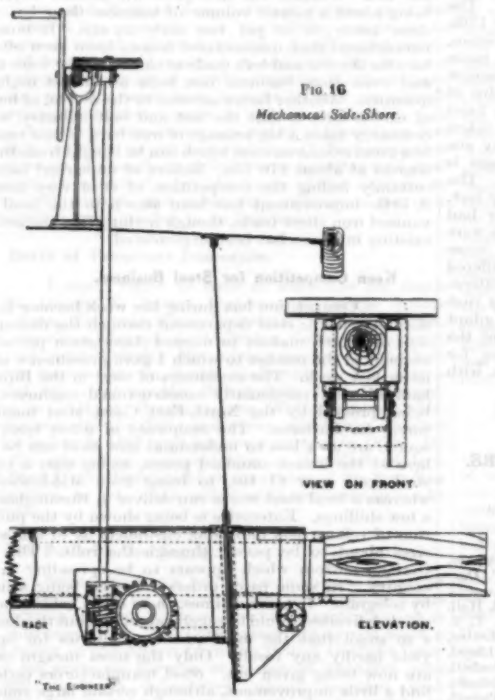


FIG. 17.—*Mechanical Bilge-Shore*

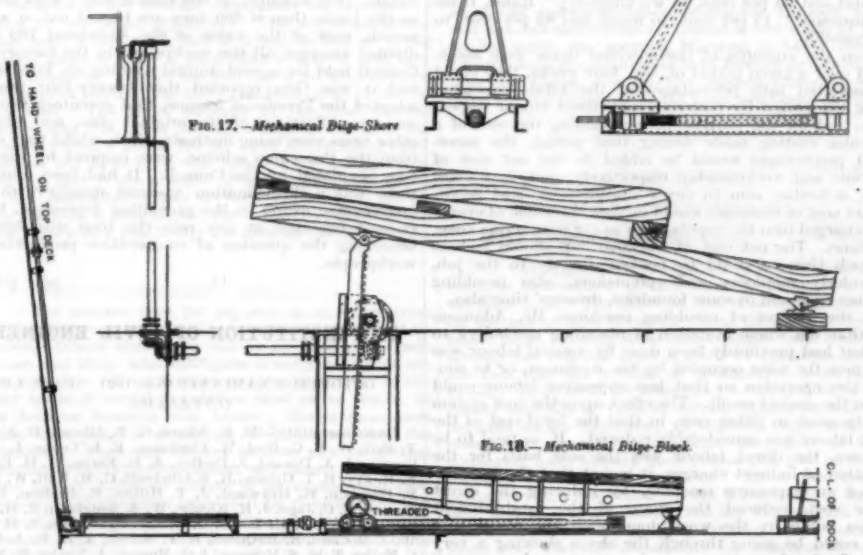


FIG. 18.—*Mechanical Bilge-Block*

BERTHING GEAR.

The berthing gear includes all the machinery necessary to haul the vessel into the dock, to centre her on the blocks, and hold her there during the period of the docking. The most important items are the capstans. These may be hand, steam, or electric. The nicest form is undoubtedly the electric capstan standing entirely upon the top deck, thus avoiding the expense of special capstan rooms. For steam docks, or where a much bigger pull is required, steam capstans are used. The capstan barrel stands on the top deck, and the engines are placed in a capstan room below. Suitable bollards and fairleads are, of course, provided.

An arrangement adopted in large docks to facilitate the entrance of ships, which is called the leading-in gear, is shown in Fig. 15. Over the whole length of both walls near the top a projecting tee-bar is arranged, which forms a runway for the small carriages shown. The ship is attached to these carriages by lengths of chain arranged dingonally as indicated in the plan. As the ship moves forward the carriages slip along the runway, but sufficient directive effort is exerted to guide and steady the ship until she is in dock. A series of chains and carriages is used, attached at suitable intervals to the vessel.

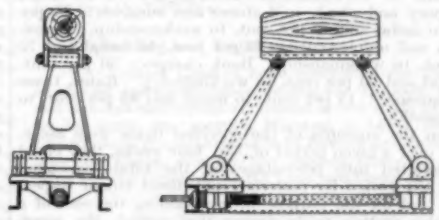
To centre the vessel on the blocks mechanical side shores are provided. One type is shown illustrated in Fig. 16. It consists of a horizontal beam of timber which works in a special tube piercing the side wall. To this timber is attached a rack driven by a pinion. This pinion is rotated by means of a hand wheel on the top deck through bevel and worm gear. On the top of the timber shore is painted a scale in feet. It is easy, therefore, by adjusting the opposite shores to equal readings, to ensure the ship being centred on the blocks. In some docks these shores are moved mechanically. A continuous shaft driven by an electric motor runs the full length of the side wall. Above each shore on the top deck is a post and hand wheel, by means of which a clutch is operated. When it is desired to move the shore the clutch is thrown into gear and the shaft operates the rack driving gear. The drive is reversible so that the shore may be moved in or out. Hydraulic shores have also been used with success. A hydraulic ram is used to move the shore in and out, but a rack and pawl, or some such similar device, is fitted to prevent the shore running back should the pressure fail. Shores are often made double; that is, two similar shores moving together are fitted one directly below the other. The inner ends of the horizontal timbers are then connected by a vertical fender, which is sometimes of the roller type.

Mechanical bilge shores have been adopted in many docks, particularly in those of the off-shore type, to support the bilges of the ships. A good type is shown in Fig. 17. The shore proper is a transverse timber pivoted near the centre of the dock. The outer end is connected to the top of a vertical strut which carries a rack. This rack is driven by means of a pinion operated by worm and bevel gear from the top deck by means of a hand wheel. By these means the shore can be raised to the right height to support the bilge of the ship. A spring timber is provided on the top of the shore as shown in the figure. This is allowed to deflect a certain amount before coming in contact with a stop, thus giving a certain amount of extra elasticity.

A second type of mechanical bilge shore is shown in Fig. 18. Here the pivoted shore is made of steel, and its lower surface is curved as shown. This lower surface rests on a three-roller carriage, which is moved across the deck by means of a long square threaded screw operated through gear from the top deck. The curved under surface acts as an inverted inclined plane, and the inward movement of the carriage causes the shore to rise to the desired height and inclination.

A third type of mechanical bilge shore or block is shown in Fig. 19. A channel iron frame resting on the deck carriet links forming a four bar motion. The top link is a flas plane carrying a timber block which supports the bilge of the ship. The lower link is a square-threaded screw carried in bearings by the channel iron frame. Of the two vertical links the lower end of the inner one is pivoted to the frame, the lower end of the outer one is pivoted to the crosshead carrying a nut driven by the screw. By rotating the screw, therefore, the bilge block can be raised to any desired height, and it automatically adjusts itself to the inclination of the ship's bottom. The screw is rotated by a shaft, which is carried across the pontoon deck and up the side wall to the top deck, where it is turned by hand gear. This shaft for a considerable distance across the pontoon deck is square, and fits into a square hole in the screw, which is hollow. The bilge block can therefore be moved across the deck to suit different widths of ships, the square shaft entering or coming out of the hollow screw.

FIG. 19.—*Sliding Bilge-Block.*



DIESEL ENGINE USERS' ASSOCIATION.

AT the last meeting of the Diesel Engine Users' Association, held at the Institution of Electrical Engineers, Mr. Oswald Wans, A.M. Inst. C.E., M.I. Mech. E., read a paper on "Some Recent Developments in Mechanical Injection Oil Engines Using Heavy Oils." The author dealt with some of the outstanding developments of two and four-cycle mechanical injection engines which had been instrumental in rendering these prime movers efficient and reliable. In connection with two-cycle engines reference was made to the light-load running gear adopted by Vickers-Petters, Limited, by means of which a portion of the fuel is injected well in advance of the main charge, thus giving the pilot charge time to vaporise before the entry of the main charge. Fuel consumptions as low as about .55 lb. per brake horse-power hour—equivalent to a brake thermal efficiency of 25 per cent.—were mentioned as having been obtained with a fuel of about .9 specific gravity and 18,300 B.Th.U. per pound. Discussing four-cycle engines, the author referred to the advantages which had accrued from the adoption of increased compression pressures, and gave particulars of the performance of a Ruston and Hornsby engine with a compression of about 425 lb. per square inch.

The general progress made with solid injection engines

during the past five years had been marked, and there was good reason to believe that the limitations of the high-compression mechanical injection oil engine had not been reached. Already engines were built developing a maximum power of 200 brake horse-power per cylinder, with a brake thermal efficiency of 35 per cent. at working load, and one might confidently expect to see in the near future multi-cylinder engines developing 800 to 1000 brake horse-power.

The further development of the oil engine, whether of the mechanical or air injection type, was largely dependent upon the materials at the disposal of the designer, and the production of metals having greater heat-resisting properties demanded the close and continued co-operation of the engineer and the metallurgist.

Foundry Costing Systems.

ON Friday last, Mr. Daniel Adamson, M.I. Mech. E., opened a discussion on "Foundry Costs and Establishment Charges" at a meeting of the Manchester Association of Engineers. The object of the opener of the discussion was to endeavour to arrive at a reliable method of estimating the cost of the many varieties of castings in green sand, dry sand and loam that are produced in the foundry attached to a general engineering business. He said that the division of the indirect charges as between the molten metal and the workmanship expended on the mould was a matter to be estimated for each particular establishment. The indirect charges should be ascertained at regular intervals, say every four weeks, and could then be allocated somewhat as follows:—Unallocated labour: 25 per cent. of this item to be charged to "metal" and 75 per cent. to workmanship account. Power: 50 per cent. to metal and 50 per cent. to workmanship. Light: 20 per cent. to metal and 80 per cent. to workmanship. Foremen's wages: 20 per cent. to metal and 80 per cent. to workmanship. Clerical charges (including management): 35 per cent. to metal and 65 per cent. to workmanship. Office expenses: 25 per cent. to metal and 75 per cent. to workmanship. Maintenance of buildings, machinery and plant, mill stores and sundries: 25 per cent. to metal and 75 per cent. to workmanship. Depreciation and obsolescence: 25 per cent. to metal and 75 per cent. to workmanship. Bank charges: 50 per cent. to metal and 50 per cent. to workmanship. Rates, taxes and insurance: 15 per cent. to metal and 85 per cent. to workmanship.

When the amounts of the specified items were ascertained over a given period of, say, four weeks, they could be converted into percentages of the totals expended during the period for materials and direct labour respectively, and for the purpose of ascertaining the cost of a particular casting made during that period, the ascertained percentages would be added to the net cost of materials and workmanship respectively, and, in normal times, a further sum to cover contingencies and profit. The net cost of materials would include the value of everything charged into the cupola, such as pig iron, scrap, coke, limestone. The net cost of workmanship should include as much time as could be booked directly to the job, particularly moulders and coremakers, also moulding machine time and in some foundries, dressers' time also.

On the subject of moulding machines, Mr. Adamson said that the whole intention of installing machinery to do what had previously been done by manual labour was to reduce the time occupied by the workman, or to simplify the operation so that less expensive labour could obtain the desired result. The effect upon the cost system was the same in either case, in that the total cost of the direct labour was considerably reduced. If, as used to be the case, the direct labour was the sole basis for the allocation of indirect charges, it meant that the installation of an expensive machine, by reducing the direct labour cost, reduced the share of the establishment charges borne by the work done, with the result that work could be going through the shops showing a very low labour cost and accordingly carrying a very small proportion of the establishment charges, and yet, at the same time, the installation of one or more expensive machines had sent up the real indirect costs of the establishment by calling for more ground space, more power, more light, more crane capacity per man employed, and it would only require a few years of development in this direction adversely to affect the profit and loss account. The author added that it was therefore essential in the interests of sound finance, when considering a machine of any kind to estimate carefully the extra cost involved in depreciation, wear and tear, tool-room equipment, and all the miscellaneous indirect charges of a modern establishment, and so ensure that the work done on the new machine was properly charged for.

A lively discussion ensued, in which Messrs. Butterworth, Cooke, Kay, Harper, Berry and Bentham took part. There was a good deal of criticism of Mr. Adamson's suggested method of arriving at costs, which one speaker said were likely to prove very misleading.

IRON ORE IN THE MALAY PENINSULA.

IN the report for 1920 of Mr. H. Marriott, General Adviser to the Government of Johore, mention is made of the opening of an iron mine on the left bank of the river Batu Pahat, a mining certificate over 50 acres having been issued to a Japanese. The ore is mainly hematite, containing about 65 per cent. of iron, and there is sufficient ore in sight for five years' working. Later information to hand, down to the end of September, shows that this deposit of iron ore is being actively worked, and that the monthly output is now 8500 tons of excellent quality. The ore is being shipped to Japan. It is reported officially that similar deposits are known to exist in Johore and other parts of the Malay Peninsula.

It would appear to be a question whether the ore can be produced at a price that would find for it a ready market. On this point, Mr. Isheharo, managing partner of Nanyo Kogyo Koshi, and who is in charge of the mining operations at Batu Pahat, has written an article which was published by a Singapore newspaper, and in which he states that hematite iron ore is the commonest form in Malaya. Magnetite is also found in some quantity; but lemontite is less frequent. He discusses the possibility of smelting the ore in Malaya, by charcoal, coke and electricity, and arrives at the conclusion that, at present at least, it is useless to attempt to smelt the ore locally. The price for which the ore can be sold in India he gives as 2 dols., in China 3 dols., and in Japan 8 dols.—the value of the Straits dollar being 2s. 4d. If exported to India or China, the price would not be enough to pay for the freight; but he states that, if a specially low rate were given to Japan, it would be possible to dispose of the ore there at a profit.

Japan's requirements are 1,200,000 tons of ore yearly. Half of that amount is already mined in Japan, and the remainder has hitherto been supplied by China. These ores contain from 50 to 60 per cent. of iron, and are bought at 8 dols. per ton, whereas the ore from Malaya contains 65 per cent. and is worth about 10.50 dols., though it has been sold at 10 dols. in order to compete with ore from other sources. The usual freight to Japan is from 7 dols. to 8 dols. per ton, and other expenses are about 3 dols. per ton. At these rates, it is obvious that it would be impossible to mine and market the Johore deposits at a profit, so the Japanese company charters steamers which would otherwise be returning empty to Japan. In a year some 50,000 tons of freight space is available in this way, and the Japanese miners are able to export the ore at the freight of 5.50 dols. per ton.

THE PRIESTMAN SYSTEM.

THE Higher Production Council is the name of a league formed some two years ago for the purpose of encouraging the adoption of profit-sharing in factories. This Council at once adopted the Priestman scheme, and has practically devoted all its attentions to that ingenious plan. The scheme was first described in THE ENGINEER of May 17th, 1918, and whilst it has met with a good deal of criticism, and even active opposition, it has continued to make progress. The basal principle of it is the division amongst all the workers in a factory of a portion of the value of work turned out month by month above a certain fixed datum. For example, if 500 tons of heavy work are taken as the basis, then if 600 tons are turned out in any one month, part of the value of the additional 100 tons is divided amongst all the workpeople in the factory. The Council held its second annual meeting on Tuesday last, and it was then reported that twenty-four firms had adopted the Priestman scheme, that seventeen firms were using modifications of the original plan, and two score other firms were using methods, which, whilst they differed from the Priestman scheme, were inspired by the literature circulated by the Council. It had been found that there was a disinclination amongst managers to adopt innovations, owing to the prevailing depression, but the Council felt that at any rate the time was fitting for broaching the question of co-operative production with workpeople.

THE INSTITUTION OF CIVIL ENGINEERS.

OCTOBER EXAMINATIONS, 1921.—PASS LIST (*INTERIM*).

Preliminary (61).—M. E. Adams, G. T. Allcock, D. J. Barnes, T. Bell, W. E. C. Bird, W. Cloutman, E. L. Cooke, L. P. Darlington, J. A. Donald, J. Dudley, A. H. Eaton, R. H. Edwards, E. R. Fry, B. T. Gibson, R. F. Gladwell, G. M. Hall, W. B. Hall, P. Harrison, R. Heywood, J. T. Hillier, R. Hudson, E. T. T. Hussell, E. C. Jago, J. H. Knight, W. A. Knighton, R. H. Latter, L. Lee-Dunham, M. Lewis, O. C. Llewelyn-Jones, S. H. Lloyd, W. J. McCann, E. McQueen, R. T. Martin, A. H. R. A. Maskell, C. Mellor, T. W. S. Milligan, J. G. Murray, A. Naylor, B. Nicholls, F. Oliver, A. C. Page, E. Parry, A. K. Pollock, E. J. Powell, H. E. G. Rayment, W. E. Reed, A. K. Richards, P. Russell, E. R. Sanderson, G. G. E. Scribante, H. C. Sharpe, B. G. Simmons, N. J. Tatman, H. W. Taylor, P. A. Turner, J. Warnock, P. N. Warren, M. Wasfi, H. Williams, R. A. Williams, W. J. Wonnacott.

Associate Membership (142).—*Whole Examination* (*Sections A, B and C*) (21).—A. C. Bedington, W. Brown, G. T. Carpenter, M.C., J. Cookman, P. T. Giles, W. S. Hall, F. S. Harrison, C. W. King, R. H. L. Lee, P. E. Masters, W. Melville, F. L. V. Mills, N. V. Modak, T. D. Newman, E. A. Phillipson, J. C. Pinto, H. G. Ramsay, J. H. M. Richards, A. G. Samuel, D. Smith, G. H. Wiltshire.

Sections A and B only (19).—G. W. Bonney, R. G. Braithwaite, H. Davies, M. A. Davis, H. Denton, I. Fraser, M.C., E. A. Lister, J. Locking, J. McCarthy, R. H. McCleland, J. McLachlan, A. Murray, P. H. Paton, O. R. Pigott, T. Price, J. A. Riccomini, A. D. Somervail, J. P. Watson, A. Webster.

Sections A and C only (2).—G. B. Dodman, W. F. James.

Sections B and C only (15).—J. Chadwick, T. Dawe, G. R. C. Fairlie, T. H. Jones, A. C. Macdonald, K. S. McClare, K. C. Marrian, W. F. Mead, J. H. Minchin, H. B. Ozanne, T. L. Parkes, A. H. Prince, H. W. Rosh, H. G. Thorpe, T. S. Vandy.

Section A only (39).—J. Aitken, G. Arnott, L. B. Aylen, G. R. Barker, E. F. Bates, B. A. Bent, J. Bleakley, L. A. Butler, A. H. Caird, S. E. Chaplin, R. D. Clark, J. S. Clitheroe, J. Cruikshank, O. R. Edge, E. H. Elgar, H. Foster, G. A. M. Gentry, H. J. Gleeson, G. C. Grove, J. Hunter, L. C. Kimberlin, T. Lewis, A. L. V. Long, H. G. McDowell, W. J. McLean, E. E. Morgan, N. R. Neal, D. R. C. Priddle, H. I. Rice, H. Ritson, J. R. Seward, L. G. Smith, W. W. Sutherland, H. P. Tame, G. H. Todd, F. S. Vernon, R. H. Wheatley, R. M. Wilkinson, M.C., E. G. Wilson.

Section B only (20).—S. A. Bradfield, T. H. Bryce, G. S. Collie, G. W. Cover, E. M. Ellis, J. Fothergill, T. Knight, W. M. Littlejohn, L. G. M. Lyon, A. J. McNeill, H. P. H. Morgan, H. D. Neep, A. J. Nichols, E. A. Rex, J. J. Roberts, R. Sawtell, W. R. Storey, G. Verity, A. D. Ward, W. D. Wilson.

Section C only (26).—J. D. Allan, H. S. Boxer, A. L. Briggs, A. Brooksbank, R. C. Callaghan, N. W. B. Clarke, B. Eng. (Sheffield), C. J. W. Cloke, L. Q. Cope, E. H. Croft, N. Drake, J. R. Everett, T. S. Griffin, B. S. Hayward, B. G. Hersey, N. K. Holmes, G. H. Humphreys, A. W. Lash, B. Eng. (Sheffield), T. T. Millar, J. Robertson, E. W. Savours, E. C. Steer, B.Sc. (Eng.) (Lond.), J. M. Thomson, B.Sc. (Glasgow), H. L. D. Tucker, J. P. Watson, T. Webster, H. Wharton.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(*From our own Correspondent.*)

Staffordshire Bar Iron Reduced 30s.

THE most important feature of the market on the week has been the reduction by 30s. per ton of the price of Staffordshire bar iron, both marked and unmarked. For some time past a very anomalous state of things has existed in the unmarked bar trade. Staffordshire and Yorkshire makers, having regard to the unresponsive state of the market, were not disposed to keep pace with the deflation in other districts, and have been holding out for higher prices than those acceptable in Lancashire. When the Lancashire makers made their basis £14, and would have put it lower but for the opposition they encountered, Staffordshire and Yorkshire mills refused to go below £14 10s. The result was that cutting by unassociated members, as reported last week, developed such dangerous aspects as seriously to jeopardise the solidarity of the trade organisation. Unmarked bars for nut and bolt and hurdle making had been offered at £13 5s. and even £13, and the Bar-makers' Association failed to exercise any effective control over prices. The Lancashire Association has now made another move by lowering the basis to £13 for its own district and for export. Staffordshire makers under the existing circumstances were forced to fall into line. They announced a reduction of 30s. per ton, bringing their price to £16 for best bars and £13 for Crown qualities, which puts them on an equal footing with other districts. The difference of £3 per ton still exists between the two qualities of bars. These are quite different prices from those which existed at the opening of the current year, for marked bars then stood at the record price of £33 10s. and unmarked bars £28 10s. Whether the new price will attract buyers or bring about a greater volume of business than has been done lately, it is yet too early to say. It must be remembered that unassociated houses have been offering bars for the nut and bolt trade at this figure for some time, and even then business has been an almost negligible quantity. Another factor adverse to the revival of buying of Crown bars is that the nut and bolt industry, which ordinarily takes a big tonnage of iron bars, is now running to a great extent on steel which can be bought from British sources at about £10 15s. Rollers of unmarked bars are certainly feeling the competition of steel very acutely. A little improvement has been shown in the local galvanised iron sheet trade, though nothing like the activity existing in Wales has been experienced.

Keen Competition for Steel Business.

Competition has during the week become keener than ever in the steel department through the determination of Scotch makers to discard Association prices—an element in the market to which I gave prominence in my letter last week. The consumers of steel in the Birmingham district, particularly constructional engineers, are being pressed by the North-East Coast steel manufacturers for business. The recipients of offers from this source are at a loss to understand how steel can be sent here at the lowest standard prices, seeing that a ton of steel costs over £1 10s. to bring from Middlesbrough, whereas a local steel works can deliver in Birmingham for a few shillings. Enterprise is being shown by the publication of rolling lists informing customers as to the actual sizes about to be passed through the rolls. This is a German custom which appears to be spreading in this country. In some cases orders are even being solicited by telegram. In normal times, these offers, which include quick deliveries, would be eagerly accepted, but the demand is so small that the most pressing inquiries for orders yield hardly any result. Only the most meagre orders are now being given out. Steel manufacturers certainly find a little improvement, although certain large concerns which had commenced on the four battleships, having had to close down through the cancellation of those orders, this district indirectly is suffering. Especially is this the case in the Dudley area, where any improvement in Admiralty work is instantly reflected upon the chain and anchor trades. That industry, however, is a little better through the slight revival in shipbuilding, due to orders for the completion of ships which have been held up for some time past. The steel re-rolling industry is experiencing a set-back in competition with the big steel works, whose recent reduction in prices has resulted in the recapture of the small bar and similar branches of production. Some Black Country mills which were restarted in the autumn have stopped again. There are more inquiries about, however, and the expectation is that these will materialise in brisker business after Christmas.

Staffordshire Cold Blast Iron.

I am able this week to announce the new price for Staffordshire cold-blast all-mine pig iron. It will be remembered that last week I stated that a furnace had once again been blown in in the Netherton district for the manufacture of this special iron. The new price has been fixed at £15 per ton. This is a reduction of 50s. per ton off the price ruling when the colliers' strike caused the blowing out of all the country's furnaces. The price is, of course, high, but when it is remembered that this iron is used only as an admixture with other foundry irons to produce high-class engineering castings, it will be recognised that there is not much to grumble about the figure with costs of material in their present condition, the more so since, as I have just shown, the price is a substantial reduction upon the figure prevailing when trade was last at normal. The poor consumption of pig iron by the forges is proving unfortunate to a number of Midland blast-furnaces which are very badly off for orders. Of all the Staffordshire blast-furnaces there are only eight in service, the rest remain idle, to the grievous loss of both capital and labour. One concern which has two furnaces blowing has not a ton of business on its books, and is putting in stock the whole of its product. Operations would probably

cease but for the fact that the blast-furnace gases are utilised for the generation of power in collieries and other departments of the firm. The constant fall in values, so far from encouraging business, has led to the postponement of orders, especially as substantial reductions in railway rates are believed to be imminent. Local pig irons are very weak, Northampton forge iron being 2s. 6d. cheaper at £4 12s. 6d. Foundry qualities remain as last week at £4 17s. 6d. Derbyshire No. 3 foundry this week was offered at £5 at works, but that was hardly a rock-bottom figure. Derbyshire forge has changed hands at about £4 15s. Should the agitation for the reduction of railway rates prove successful, it is concluded that this will further weaken prices, although smelters state that they need the rate reduction to recoup the losses already sustained in production. Cleveland pig has this week fallen a further 10s. per ton, and it is felt here that local makes will have to concede more than the 2s. 6d. which has been the extent of the drop during the past week.

Colonial Water Tube Boiler Order.

Additional details concerning the valuable colonial engineering business which has just been secured for this district, as announced in my letter last week, show that the contract consists of twelve "Thompson" patented vertical water-tube boilers, for working at a pressure of 200 lb. per square inch, each to evaporate 70,000 lb. of steam per hour, superheated to 650 deg. Fah. Each boiler will be supplied with forced draught travelling grate stokers, to burn a local brown coal. The plant is intended to work in connection with a power station at Morewell, near Melbourne, which is being erected adjacent to the fuel bed, for supplying power to the district. The execution of the contract, which was secured by J. Thompson, Limited, of Wolverhampton, who are to be warmly congratulated on it, will afford employment to over 1000 workpeople.

Will Railway Rates Fall?

The agitation against the high railway rates continues, and Midland iron and steel masters hold the view that it lies primarily with the railway companies to promote or retard a general revival. An all-round reduction of freights, they contend, would probably be more efficacious than any other possible resource. Extraordinary pressure has this week been brought to bear on railway companies and their agents to obtain concessions. In some cases attractive orders are stated to have been lost through inability to get lower charges. Representative deputations of Chambers of Commerce and iron and steel interests have waited upon the heads of the railways to press their claims, and substantial reductions are now believed, in some circles, to be imminent.

Death of Prominent Ironmaster.

I much regret to have to announce the death of Mr. George N. Adams, chairman of George Adams and Sons, Limited, Mars Ironworks, Wolverhampton, and chairman also of the Aldridge Colliery Company, Limited, near Walsall. Mr. Adams was one of the best known ironmasters in South Staffordshire, and was a regular attendant on the Birmingham Iron Exchange. Born in 1854 at Bradley, near Wolverhampton, Mr. Adams went to the Mars Ironworks, which was founded by his father in 1867, and became a partner in 1879. He was the employers' representative on the Midland Iron and Steel Wages Board, and as a member of the Standing Committee, he was often called in to arbitrate in works disputes.

The Potteries Gas Supply.

Something like a revolution in the gas supply of the Potteries will be effected when the Stoke-on-Trent Corporation's ambitious new scheme of centralisation is put into operation. The Corporation has agreed upon a bold policy in purchasing from the British Gaslight Company its works at Etruria, at a cost of £345,000, plus £40,000 mortgage debentures, which, together with £15,000 for transference costs and compensation to officials, will make a total sum of £400,000. At present the Corporation owns four gas undertakings in the Potteries. The present scheme, which is awaiting parliamentary sanction, has been embarked upon by reason of the fact that the Corporation was faced with an expenditure on all its works amounting to a total of £285,000 during the next ten years. Even that large amount in repair and renewal plant, however, would not result in permanent efficiency. The new scheme provides for the centralisation of the manufacture of gas for the whole of the Potteries area. It is believed that, apart from being more efficient, the scheme will result ultimately in reduction in the price of gas averaging from 9d. to 1s. per thousand cubic feet. The Corporation will probably take over the new works in the spring of next year, and the whole work is expected to be completed in five years.

Birmingham's Army of Unemployed.

The unemployment returns for Birmingham for the week ended November 18th showed a further increase in the number registered at the unemployment exchange. There were 87,075 persons either out of work or not employed more than three days a week, as against 83,196 a week earlier. Of the 87,075, no fewer than 80,116 were wholly unemployed, of whom 51,472 were men, as against 76,536 and 48,352 respectively the preceding week. The total for the West Midlands area increased to 213,445 from 207,013, a rise of more than 6000.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER, Thursday.

Iron, Steel and Metals.

THERE is as yet very little change in the general condition of the iron and steel markets or in the non-ferrous metal markets, except that of tin. The trade all round is in a very dull state and consumers continue to buy small quantities only for prompt consumption. The old practice of looking far ahead and securing requirements for six months or a year has not yet been resumed, and the reason seems to be that consumers expect always to be able to secure what is practically immediate delivery, and are under no necessity to hold stocks for the purpose of safeguarding their supplies. There is also a very widespread belief that the longer purchases are delayed the lower will be the price, although that belief can scarcely apply now to such articles as copper and spelter. This tendency to retail buying in a falling market is quite a common trait of all consumers, and is generally maintained up to the time when markets begin to improve, and then there is a rush to buy, which spoils the chance of getting in at the bottom.

Metals.

In the standard copper market the tone is thought to be a little better, but there is as yet no indication that speculation in copper is reviving. The improvement in the feeling is perhaps caused by better reports from America, but it is not yet clear that the consuming trades there are very active. Perhaps people are going on the returns of the October sales of copper in America, which were larger for that month than for any other month of the year. Some of this, of course, will be forward selling, and it is believed that the actual rate of consumption has not increased to any extent yet. It seems probable, however, that the early signs of recovery from the industrial depression into which the world has been plunged will first be recognisable in America. One fears, however, that this recovery cannot take place until some progress has been made in the relief of the poverty of the world. America, of course, is not poor, but all her customers are, and some of them owe her vast sums. Nevertheless, it is probably true that the prices for copper are at the bottom, and that whatever happens to the trade consumption, they cannot be depressed any more. Consumers of manufactured copper and brass would be more likely to consider the propriety of placing orders in advance of requirements if the prices of these manufactures were brought into proper relationship with the metal market; but the present margins for manufacturing costs are in almost every case extravagant, and in some cases absolutely grotesque. The market for tin has shown decided improvement of late, partly no doubt in consequence of the larger demand from the tin-plate trade, but perhaps more because of the evident disposition on the part of America to buy larger quantities. The actual statistical position here is not good, but it is not so bad as it has been, and there is quite a good chance that it may continue to improve. Part of the late rise is no doubt caused by speculative buying, but there has been some industrial buying also. The great strength of the lead market continues, and the prices are again higher. Lead is the only metal which is about 100 per cent. above the old pre-war levels, but apparently the demand keeps well up to the supply, and in the absence of any large contributions from the Australian mines it may continue to do so. Spelter has been a little better, but it does not move much, and the price is now practically the same as that for English lead.

Pig Iron.

The market here for pig iron is in a comatose condition, and very few people are inclined to buy. It is, of course, obvious that there can be no revival in trade this year, and those who anticipate it early next year are only a very few. Even if there were some revival in the foundry trade it would not follow that prices would be higher because business was better. Hence consumers continue their practice of putting off purchases until the last moment. They can always be sure now of getting the iron at a day or two's notice, and hence there is no need to buy in advance. There is an expectation here that the Cleveland official price will be reduced, but one can scarcely think that this reduction can be more than 10s. per ton, and in that case the alteration will not be of much interest to Manchester buyers, because at £5 on trucks the iron would cost more than the present price of Derbyshire when delivered in Manchester. Whilst the present dearth of orders for castings continues there is no probability that any better buying of pig iron would occur, no matter what concessions might be offered in the price, and it is generally maintained that the present prices are below the cost of manufacture. Nevertheless, it is highly important to get the prices down to the bottom, for until this process is completed there cannot be any improvement in trade.

Finished Material.

As was anticipated, there has been no more buying of finished iron at the reduced prices than there was before, and, of course, finished iron prices are grossly out of all relation with finished steel. A few orders for the latter dribble in occasionally, but there is no large buying at present. Here the prices are unaltered, and one does not hear of much change in the continental prices, except that foreign steel plates are offered at a low rate. It is said that German plate steel is to be had at less than £8 per ton f.o.b., or at about £8 10s. delivered.

Scrap.

The market here is now almost dead for all kinds of scrap material. Even foundry scrap, which was the last kind to feel the depression, is very difficult to sell now unless low prices are taken, and even then the demand is for small lots only. The best textile scrap is in a better state than common scrap, because of the comparatively high prices for Scotch pig iron.

Barton Super Power Station.

A visit was recently paid by the members of the Electricity Committee of the Manchester City Council to the new power station which is in process of erection on the banks of the Ship Canal at Barton. The work commenced in March last year, and it is anticipated that a supply of electricity will be available in about twelve months time. The cost of the new works will be about £2,300,000 for an installed plant capacity of 75,000 kilowatts at normal rating. This will be obtained from three turbo-generators, each of 25,000 kilowatts capacity, supplied with steam from ten water-tube boilers each capable of evaporating 120,000 lb. of water per hour at a maximum. In addition to their large size, these boilers will also be remarkable for their strength, as the steam pressure is to be 375 lb. per square inch. The site of the station was well chosen. The foundations are excellent, and, being near the Ship Canal, ample water will be available for condensation purposes. The number of men engaged upon the site of the works is 361, and there are over 500 men engaged in cable laying between Barton and the existing area of supply.

BARROW-IN-FURNESS, Thursday.

Hematites.

The position in the hematite pig iron trade of this district is unchanged. Taking the whole of North Lancashire and Cumberland, there are only seven furnaces in operation, and as the output is quite sufficient to supply all wants for the present, it is not expected that the position will improve until into next year. The whole trade is still unsettled, and the cry for still further reductions in price cannot be met whilst raw materials are at such a high figure and railway rates are so high. A good proportion of the output is finding an outlet at neighbouring steel works. Prices are unchanged on the week.

Iron Ore.

There is a quieter demand for iron ore on account of the damping down of the Ulverston furnace, and this is reflected at the mines where those pits that are not on short time are closed down entirely. Foreign ores are being imported into Barrow for local use.

Steel.

There are no new features to report in the steel trade. Business continues to be very quiet all round. Rails continue to occupy the chief of the attention of makers, an Indian order keeping the mills going. Hoops are being rolled and other departments are engaged, including the foundries.

Shipbuilding and Engineering.

Vickers Limited have completed the fitting out of the oil carrier Scottish Maiden for Tankers, Limited, and she has undergone successful speed trials at sea. A similar craft, the Scottish Minstrel, is being fitted out. The whole of the departments at Barrow are slack, except that two liners, one for the Cunard Company and the other for the Commonwealth Line, are being fitted out.

SHEFFIELD.

(From our own Correspondent.)

Hope Abandoned for this Year.

IT is generally recognised here now that no hope need be entertained of any trade recovery this side of the New Year. The effect of the Washington discussions on the heavy steel departments of Sheffield is being felt much more severely than most people can realise, and already the reaction from a spirit of optimism is seen in the fact that the number of unemployed is rising again locally. In some of the armament works notices have been posted that the services of certain employees will not be required at the expiration of fourteen days, and a good many men, recently taken from the ranks of the unemployed, have already been discharged, just as they had thought themselves "in clover" for a few months—perhaps even a few years. There is the irony of the situation, and it is to be feared that the Washington specific, whilst it will doubtless bring satisfaction to many, will mean very hard Christmas fare for numbers of workers. In other directions, too, the indications of anything like a substantial trade recovery appear to be fading, and whilst it is certain that this phase is but a temporary one, to be followed sooner or later by an industrial revival in which all will share, conditions at the moment are disturbing. These opinions, I know, appear to contradict the suggestion of growing optimism made in my letter last week; but the truth is that in the prevailing uncertain state of things, hopes and fears are rising and falling with the regularity of the tides, and the optimists of to-day are the pessimists of to-morrow. Yet there is no need to lose heart. There is still sufficient evidence to justify one in declaring that in spite of all the adverse influences at work, a distinct undercurrent of hopefulness exists. Even in the heavy steel departments there are a few really important contracts in hand, while in the lighter sections patches of activity are not at all uncommon.

Where Business is Brighter.

One firm here is putting up a splendid attempt to combat the inroads in the home market of United States circular and other saw manufacturers, and is producing, for the first time in this country, I believe, inserted tooth circular saws. The recovery in the tin-plate industry is having a good effect here, and since last week there have been further developments in the motor steel trade. Iron-foundries, too, are promising better things now, and the fact that continental rivals, and especially German rivals, are no longer formidable competitors is putting a lot of new hope into makers of iron and steel. Some of the lighter steel manufacturers say they are not being hit nearly so heavily as are producers of heavy steel, and are able to maintain a fair volume of exports to South America, India and the Colonies at rates which will allow a quite reasonable margin of profit. Considerable preparations are being made for the development of the wonderful new material "rustless iron," and one firm is said to have acquired an invention for the production of carbon-free and low carbon ferro-chrome by a process which should largely reduce the cost of manufacturing stainless iron—the high cost of the material being at present one of the points against its very speedy development High-speed

steel continues in a precarious state, with very small hope of any immediate escape from this prolonged and disastrous slump, but since my previous letter I have received a note from a director of a well-known local firm of refractory makers. The note was provoked by a remark of mine that makers of refractory materials were having a pretty rough time, and the writer of it, while admitting that the statement was "quite true in a great measure," declared that his company has not suffered to any appreciable extent. "We have not been over-flush with orders," he added, "but as far as our fire-brick works are concerned, we have not worked on short time yet; in fact, we have not lost any time during the last twenty-five years owing to bad trade. We have lately been favoured with several large foreign orders for steel runner bricks, &c., for South Africa, Spain, Japan and other countries, and these, of course, have helped to keep us going. Our ganister works have not been quite so fortunate, but even they have never worked less than four days per week."

Profit Out of Waste.

A rather interesting report on the municipality's profits out of waste material has just been issued, and shows that the quantity of refuse handled during last year was 16,622 tons in excess of the average of the previous five years, which is taken as evidence of "deterioration in the quality of the coal supplies." By means of the screening plant, 716 tons of fuel were recovered, out of 3259 tons of material treated, and used for steam-raising purposes at the public baths. The plant for the treatment of oily waste has proved very successful, as has the employment of electric vehicles for transport.

Wages Deflation.

The process of wages deflation is claiming a very great deal of care and attention just now, though, of course, everyone knows it to be inevitable. Late last week a conference of representatives of the Federated Steel Makers' Association and the Iron and Steel Trades' Confederation regarding the wages of men employed on open-hearth furnaces was held in Sheffield. The point under discussion was a reduction in the war bonuses to the extent of 11s. 6d. per week per man. The case for the employers was entrusted to Mr. J. E. Baker, while that for the men was in the hands of Mr. John Hodge and two divisional officials, but after a very lengthy meeting the proceedings were adjourned, no decision having been reached. Something more definite was done, however, as the result of negotiations between representatives of the employers and men in the lighter steel trades, including makers of edge tools, spades, forks and shovels, scythes, sickles and hooks and hammers. In this case the proposal was a further reduction of wages equivalent to the 12½ per cent. reduction in the engineering and foundry trades. The wages of the men in the lighter steel industry were increased during the war by amounts similar to the increases granted to the engineering trades. Negotiations have been proceeding for some time, the proposal being that wages should be reduced by 6s. 6d. per week as from September 1st, but the employers agreed not to put the change into effect until January 1st, and on that understanding the workers were officially recommended to close with the offer. Regarding the presence in Sheffield of Mr. John Hodge, the well-known Labour leader gave a rather curious reply to a question put to him as to whether he could suggest anything that would be likely to improve the industrial conditions he so deplored and about which he seemed to be very pessimistic. "I think," he replied, "if the railway companies would place big orders for steel rails, whether they need them or not, that would be one way. The Government surely could do this under the Trade Industries Bill, under the credit system."

Rolling Stock Building.

There seems very little ground for hope in that direction, however, for experience of railway steel makers and rolling stock builders, from what I have been able to gather is that immediately on State de-control railway orders dropped like a piece of lead, and the position of the companies now is that they are waiting to see how the grouping system will work out before placing orders for much new work. What is hoped for is a very considerable economy in rolling stock and everything else connected with railways, and if that hope materialises there would seem a very thin chance of the companies placing steel rail orders for the sole purpose of relieving unemployment. On the contrary, the companies, by the very operation mentioned, are much more likely to create unemployment, as, in fact, it seems inevitable that they will do. When the grouping system has settled down, railway contracts will come forward more freely, no doubt, but it would be rather surprising were they to show an increase in bulk. I seem to remember a remark in the Leader pages of THE ENGINEER at the time when the armament firms were turning their attention from warlike productions to rolling stock building, that time alone would show the wisdom or otherwise of costly development in that direction, and to-day I am thinking that a good deal of the first enthusiasm has gone—perhaps for ever. By the way, Clayton Wagons, Limited, of Lincoln, has recently booked some quite good orders on Indian account, including twenty-five carriage steel underframes and bogies for the Burma Railways, 300 sets of covered goods wagon fittings for the Bengal and North-Western Railway, and twenty third-class carriage steel underframes and bogies for the East India Railway.

The Coke Oven Slump.

The newly elected chairman of the Midland Section of the Coke Oven Managers' Association—Mr. J. A. Davy—speaking at a gathering of the Association in Sheffield on Saturday, said that coke oven managers had experienced a trying time, consequent on the depression in trade generally and the coal strike, which caused the whole of the coke oven plants to shut down completely or to continue working with very little fuel to keep the ovens warm. Large numbers of plants were still cold, with no immediate prospect of being put into operation. During the last few weeks, he added, the position had certainly brightened, a few blast-furnaces having resumed work, and they hoped, for the sake of their own industry as well as other trades, that the iron market would revive to such an extent that works would soon come into full operation again. They were well aware of the heavy fall in prices of all the products manufactured in the coke oven industry, and it behoved them as managers, in these tight times, to turn to account all the available resources at their disposal.

A Good Point Gained.

Sheffield steel manufacturers who use the Port of London for consignments abroad are very pleased with the result of representations made through the medium of the Associated Chambers of Commerce. It appears that the practice has been that before railways would accept such consignments an advice note had to be received to the effect that the vessel by which the goods were to be consigned was in a position to accept cargo. In spite of that, however, when for any reason, such as the ship being full and the goods having to await another vessel or other cause, there was delay, demurrage was incurred, demand for payment of which was made on the trader by the railway. The Sheffield Chamber of Commerce has constantly advised its members to refuse payment, and claimed that if any delay occurred the railway company or the Port of London Authority or the shipowners were responsible. As the result of a conference of interested parties, called by the Board of Trade, very satisfactory terms have been agreed on:—(1) Shipowners will accept liability for demurrage if incurred (*a*) after they have authorised cargo to be accepted, (*b*) when traffic is invited prematurely, and (*c*) when goods which the shipowner has undertaken to accept are shut out; (2) the Port Authority will accept liability for demurrage incurred when it is itself responsible for the detention of a wagon beyond the prescribed time; (3) traders will be liable for demurrage if incurred when goods are sent to the docks without any previous inquiry or an arrangement with shipowners.

NORTH OF ENGLAND.

(From our own Correspondent.)

The Chief Obstacle to Trade Revival.

IT cannot, unfortunately, be said that there is any very perceptible improvement in the general industrial position or the outlook, and none is now looked ior until the turn of the year. The stagnation in the fron and steel and allied trades remains practically unrelieved. The industry is, indeed, passing through the most trying period ever experienced. Business has reached its lowest ebb, despite the great sacrifices made by manufacturers in cutting prices below the cost of production in their efforts to bring about a revival. A survey of the present position is more than sufficient to confirm the view that the continued and tremendously havy burden of transportation charges constitutes the main factor in retarding trade. The fact that the industry generally to-day is employing less than 50 per cent. of the numbers of a year ago clearly differentiates the industry from others. There is, in fact, no other industry which has such unemployment figures, and notwithstanding that prices of steel products have been drastically cut, materials such as ship plates, joists, angles, rails, &c., averaging roughly 40 per cent. over the pre-war prices. Even this of itself has not given any definite assistance to the industry. Whilst it is true that the railway companies have made reductions on certain raw materials, fuel is not subjected to this reduction, and the sum total is under 4 per cent. of the transportation charges on the finished products, and is therefore absolutely negligible, the level of railway rates still being maintained at an average of 112 per cent. over the pre-war figures. Wages have been reduced, and will continue to be so reduced under sliding scales, and the prices of coke are falling simply because it is absolutely impossible to pay higher prices.

To Meet Competition.

The services of transportation play one of the most important parts in the cost of the production of steel, and although to-day's prices are not of themselves sufficiently low to stimulate trade, costs cannot possibly be brought down, even to the prices that are to-day being charged, in order that products can be marketed and exported as economically as possible, in order to keep pace with the continental and foreign competition. Whilst railways are content to levy high charges, it must automatically follow that their traffics will continue to be immensely reduced, which is simply the operation of economic law, namely, that of increasing costs and diminishing returns. If trade is to be encouraged the railway companies must boldly take risks and lower their charges in order to stimulate traffic and rebuild the prosperity of the country. The North-East Coast iron and steel trade is undoubtedly in urgent need of a bold policy of this kind.

Cleveland Iron Trade.

At great sacrifice the Cleveland ironmasters have made another all-round cut of 10s. per ton in the agreed minimum selling prices, and there are hopes that this will have the effect of so stimulating demand as to permit of still more furnaces being put into operation. Even with this latest reduction, however, continental foundry iron can be landed in Scotland cheaper than Cleveland iron owing to the high transport charges; but it is understood that the decision of the railway companies regarding freight rates will be made known on or before December 10th, and if a reasonable reduction be made the revival of the Cleveland iron trade should be in sight. There has been no fall in working costs to warrant the latest cut, and it reveals the extent of the sacrifice which the ironmasters are prepared to make in order to get their works going again. It is also to be remembered that each fall in prices hastens the fall in wages under the sliding scale, so that workers and employers alike will share in the sacrifice. It is gratifying to learn that there has been a revival of interest in the Cleveland iron trade amongst foreign buyers who prefer the Cleveland product, but very little export business is possible owing to the adverse state of the exchanges.

Hematite Pig Iron.

Four more blast-furnaces are shortly to be put into operation in the East Coast hematite pig iron trade, and when they are started there will be twenty-four blast-furnaces operating on the North-East Coast, thirteen of them on hematite. It cannot be said, however, that there is as yet any substantial advance in the demand, but evidently the prospects are brighter. Still, competition for orders is very keen, and whilst 110s. per ton is still quoted for mixed numbers, buyers with good orders to place are able to get concessions.

Iron-making Materials.

The starting of four more furnaces will also, it is hoped, assist the fuel and foreign ore trades. With so many ovens idle, coke makers are very keen for orders, and prices vary somewhat, but average furnace qualities are around 30s. per ton delivered. There is extremely little business in foreign ore, but prices are, if anything, a shade firmer, and 27s. is now quite a minimum figure for best Rubio ore c.i.f.

Manufactured Iron and Steel.

There is little new of moment in the manufactured iron and steel trade, and although manufacturers are sparing no effort to secure orders to keep their plant in operation, no improvement seems likely until the turn of the year. The area and price agreements still remain in force amongst the English makers, but there is free competition for foreign orders, and it is said that home prices will be cut to the extent of 20s. to 30s. per ton, notwithstanding the fact that even home prices are below cost. No further price changes are recorded.

The Coal Trade.

The whole tone of the Northern coal trade, for the rest of the year at least, has undergone quite a definite change for the better. There has been quite an influx of orders, and the position of the collieries is more favourable than for many months past. Best steams, in both Northumberland and Durham, are experiencing a rather vigorous demand, and are fully booked up to the end of the year, and in some cases collieries have in hand inquiries up to March next. Prices of steams, though firmer, are not materially altered, but some operators are anxious to book up in anticipation of a possible inflation as the end of the year approaches. In other sections of the market there is little alteration. The Durham market is not quite so favourably placed as the harder fuels of Northumberland, but there is a tendency towards an opening out of the trade, and as a rule discounting has ceased, while attempts are being made to improve current figures. Gas coals are a shade steadier all round, with bests and specials distinctly better. Bunkers and coking coal are still easy, but opinion seems just now to regard the present list as the minimum, with a possibility of a slight advance when purchasers' terms will permit. The coke market is not appreciably altered. The tone is still weak for all classes of foundry and furnace coke, with beehive, though restricted in quantity, still ample to cover all requirements of the trade, while patent oven is still offered freely at minimum quotations. Gas coke, on the other hand, maintains all its recent strength, and being supported by a steady and regular demand, the present range of prices are likely to continue undisturbed for a little while.

Cleveland Miners' Wages Reduced.

The abolition of the 8s. a day minimum and the reduction of wages by the dropping of the 5½ per cent. increase granted about six weeks ago were the proposals made by the employers at a joint meeting of the Cleveland Ironstone Mineowners and the miners' representatives on Monday. The men resisted the claims, but it was finally decided that the 8s. minimum should cease at the end of this week. This means that, commencing from Monday, no man will be paid more than the base rate and agreed percentage actually earned by him. It was agreed, however, that the increase of 5½ per cent. should continue until January, when wage rates will again be discussed.

SCOTLAND.

(From our own Correspondent.)

Dull Markets.

THE depression in almost all branches of industry is still most marked, and there is little indication of any improvement of importance before the end of this year. Here and there gleams of hope arise, but as a rule prove of little real significance. Markets generally are very dull, and the remedy obscure. All classes of materials have dropped to levels more compatible with competitive quotations, but expansion in business has not followed. Consumers are either not able to purchase or are still determined to hold off in the hope of forcing values down further. In many cases, however, producers state that to manufacture at present entails a serious loss, and on all hands one hears rumours of wholesale closing down of factories now in operation. Whatever may be the cause, markets are undoubtedly in a deadly dull condition and works everywhere are deriving very meagre support. In a number of cases only from two to three days' work per week is possible.

To Provide Work.

Though some are of the opinion that the suspended Admiralty work may yet be resumed, though perhaps not so fully as was originally intended, there is a

great necessity that something should be done in the meantime to provide work on a large scale. Various improvement schemes are in prospect, and some may be proceeded with almost immediately. These include operations on the Clyde in the nature of extensive new docks at Renfrew and also a new bridge over the Clyde. The latter has been on the way, or rather under discussion, for a number of years as a means of relieving traffic congestion in Glasgow, and is now to be proceeded with. It is hoped that preliminaries will be settled speedily. Many other projects have been mooted, but are mostly still in a negative state. The financial aspect is, in the majority of cases, a difficult obstacle.

Pig Iron.

The pig iron trade in Scotland proceeds on very restricted lines, and little alteration is noticeable as week succeeds week. While quotations are now approaching marketable levels the production is not being fully disposed of, even though the furnaces in operation only number some eighteen or so. Dullness at consuming works is largely responsible, and little or nothing is being done for overseas delivery.

Steel and Iron.

Conditions at the steel works are not improving. New business is of small dimensions, and those establishments still open are only working on an average two and a-half days per week. As already stated last week, the Scotch producer is evidently not yet in a position to quote the same prices as competitors in England, and the latter are able to deliver material in the Clyde area below the purchase price of local products. At the moment there is a better inquiry for steel sheets. South America, Australia, and India are all interested, and a fair supply of orders is expected in the near future. Very little is being done in castings, but tube makers have a trifle more work on hand. Malleable iron makers have secured some business, doubtless owing to the recent reductions, but it remains to be seen if this improvement will last. There seems every reason to suppose that, while consumers take momentary advantage of reductions in price, the bulk of the business awaiting is held up until prospective buyers are convinced that rock bottom levels have been touched. Consequently many schemes are held up, and only absolutely necessary work proceeded with. Export shows no sign of increasing despite cheaper freights.

Wages in Malleable Iron Trade.

In view of the fact that the selling price of iron during the months of September and October of this year is certified at £15 10s. 2.17d., the wages in the Scottish manufactured iron trade fall to be reduced by 15 per cent. on basis rates.

Coal Trade.

The tone in the Scotch coal trade has improved somewhat. This cannot be attributed to an increase of any importance in business, but presumably to the fact that in the opinion of many the period of depression is coming to an end. So far as regards the home trade little change is noticeable, and business is largely confined to requirements for railways, gas companies and household consumption. Industrial demands are still of a very meagre description. The export position is somewhat better, however. Collieries in the West of Scotland have good shipping orders for ells and splints, and prices of the latter are inclined to harden. In the Lothians and Fifeshire a moderate turnover in treble and double nuts for overseas delivery is reported, and in the latter district single nuts also have secured a fair amount of business. On the whole, however, single nuts and smaller descriptions are languishing and easily procurable at prices considerably below the figures named in open market. Aggregate shipments for the week amounted to 223,117 tons against 190,021 tons in the preceding week, and 335,767 tons in the same week in 1913.

Low Wages.

The extremely low wages earned by surfacemen and other labourers in the Scotch coal trade is creating considerable attention, and a statement on the matter will be submitted to the next meeting of the Wages Board. It is said that some of the men are getting less than 30s. per week.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Situation.

On the whole the conditions prevailing in the coal trade are improved, but it is not an all-round progress that has been made. The better demand for supplies does not apply to all descriptions, the result being that while some collieries are very full up and have quite good stems from now pretty well up to the Christmas holidays, there are other concerns which find it very difficult to get along. The fall in the price of coal, without anything like a corresponding reduction in working costs, is hitting some undertakings very hard, and there is more than one important company which will have to have a straight talk with its workmen on the subject of output, otherwise the question of suspending work at the collieries until the times get better will be seriously discussed There is no doubt that the market would be on a different footing if the home demand for fuel was on anything like a normal scale, or if it had expanded in proportion to the foreign inquiry during the past week or two. Thousands of tons of coal which would be going inland if our various industries were actively engaged, particularly the iron and steel trades, have now to find an outlet at the ports for foreign consumption. This is undoubtedly responsible for the market not being steadier than it is at present, but no great improvement is looked for until about April of next year, when it is hoped that the conditions, both at home and abroad, industrially and financially, will be more settled.

Coal Board Chairman.

The announcement was made on Tuesday that Viscount Buxton had been nominated by the Speaker of the House of Commons as independent chairman of the Joint District Board for the South Wales coal trade. The Speaker's nomination was accepted at a meeting of the Joint Board at Cardiff by both the owners and workmen's representatives. As Mr. Sydney Charles Buxton, the new independent Chairman represented Poplar in the House of Commons from 1886 to 1914, when he was appointed High Commissioner and Governor-General of South Africa, an office which he recently relinquished.

Miners' Wages.

Another attempt has been made this week to come to an agreement on the question of a subsistence wage for the lower-paid workmen in the coalfield. When the Joint Board met a week ago the men's leaders put forward an application for a graduated scale of allowances under which no adult workman would receive a lower standard rate than 6s., or a minimum of 7s. 8d. per day. The owners agreed to the principle, but could not accept the figures suggested, and stipulated for discrimination being made between married and single men, and workmen who were paid seven turns for working six. Since then the Sub-committee appointed by the Board have had the matter under consideration, and the proposals, as amended, have been discussed by the Council of the South Wales Miners' Federation, and have again come before the Joint District Board, but at the time of writing the decision of the latter body was not known.

Dock Workers' Wages.

For some months past the Shipping Federation has been conferring with the National Transport Workers on the question of the revision of the tariff to apply to dock pilots, boatmen and riggers; but unfortunately it was found quite impossible to come to an amicable agreement, owing to the uncompromising attitude of the latter. The result has been that the Shipping Federation has issued its new tariff and conditions which members are to insist upon when employing the workmen referred to above. This new tariff reduces the men's wages from about 116 per cent. above pre-war level to about 60 per cent. over the pre-war level, and sweeps away many conditions which crept in during the war, and which are regarded as objectionable. The men's representatives met over last week-end to consider the situation, but they decided to reject the shipowners' tariff, and to offer their services at a higher scale of remuneration. The new tariff came into operation on Monday last, on which day the shipowners conferred with the shipbrokers in order to consolidate their opposition to the workmen, and provide that as far as possible their terms shall apply, not only to British boards, but foreign vessels coming to this district. The men's terms are practically 100 per cent. above the pre-war level. Although the owners and the workmen are so far at complete variance, the position is that there is no real strike. In cases where the men's services were requested on the basis of the owners' terms and refused, the ships have done without them, and the work has been carried out by the officers and members of the crews, with the result that no vessel has so far been held up or delayed.

Current Business.

The tone of the steam coal market is irregular, and prices of similar quality coals vary to some extent. It is altogether a question of position, but on the whole there is slightly more activity, for the reason that shippers are showing a disposition to get their coals booked up and shipments effected during the early part of next month, instead of leaving it until later when the holidays may increase their difficulties in getting particular grades. Some collieries are already well sold for the next few weeks, and consequently are holding firmly to their quotations, but others are less fortunate. There is a fair number of inquiries about for supplies of steam coals and patent fuel for delivery over the next two or three months, and in an isolated case or two for shipment over the whole of next year, but it is invariably the case that buyers expect to discount present prices considerably. About 20,000 tons of superior Monmouthshire large coals have been sold for South America at the price of 42s. net c.i.f., which on the basis of the current rate for the Plate leaves about 22s 6d. to 23s. for the coals, which are for shipment from now over the next three months. Best Admiralty large are quoted at 25s. 6d. to 26s., and second qualities are 24s. 6d. to 25s. Smalls keep steady and patent fuel stands about 25s. 6d to 28s. 6d. Pitwood is about 40s.

Latest News from the Provinces.

NORTH OF ENGLAND.

Coal Miners' Wage Cut.

Northumberland miners suffer another reduction in wages in accordance with the accountants' ascertainment which governs wages for December. Wages will be 107.35 per cent. above the basis rates, or 38.23 per cent. above wages in 1914. Compared with November, there will be a reduction of about 8½d. per shift in respect of the higher-paid men, and about 5d. per shift for lower-paid men.

Realised Prices of Manufactured Iron.

The report of the accountants to the Board of Conciliation and Arbitration for the Manufactured Iron and Steel Trade of the North of England for the two months ending October 31st, certifies that the average selling price was £15 13s. 6.84d. per ton, as compared with £16 13s. 4.77d. per ton in the previous two months. In accordance with the sliding scale arrangement there will be a reduction of 10 per cent. on puddling and other forge and mill wages, to take effect from November 28th. Since the beginning of the year wages have been reduced by 137½ per cent. They are, however, still 87½ per cent. above the base rate.

WALES AND ADJOINING COUNTIES.

Miners' Wages.

No agreement has been come to regarding the miners' application for a "subsistence" wage for the lower-paid men. The Joint Coal Board meeting resulted in the men's leaders agreeing to substitute the owners' offer of a minimum daily wage of 7s. 2d. as against their figure of 7s. 8d. per day, but they declined to accept the owners' qualifying conditions. The men's leaders intimated that they would lay the facts before the delegate conference to-morrow (Saturday), so that acceptance of the scheme rests with the delegates.

Examiners' Wages.

Representatives of the coalowners and the South Wales Colliery Examiners' Association have agreed to the following minimum rates to be operative during December:—Examiners, £4 2s. 6d. per week; shotsmen, £2 17s. 6d. These compare with £5 13s. 6d. and £4 1s. respectively previously in operation.

Swansea Metal Exchange.

The conditions in the tin-plate trade are very steady. About 75 per cent. of the mills are operating, and in most cases working regularly. More inquiries are in the market for Central America, Argentina and Mexico. The galvanised sheet market shows no new feature, and sheet and tin-plate bars remain at the official minimum of £7 15s. per ton.

AUSTRALIAN NOTES.

SYDNEY, N.S.W., October, 1921.

A Colliery Disaster.

One of the most appalling colliery disasters that has ever taken place in this country occurred at Mount Mulligan (Q.) on September 19th last, when all the men in the mine at the time of the explosion, to the number of seventy-five, lost their lives. As gas troubles are not encountered here, all the mines are worked with naked lights. It is believed this explosion was due to coal dust.

Wages and Hours of Labour.

As the high rate of wages necessitated by the war has not yet been reduced throughout Australia and as the Arbitration Court has reduced the hours of labour, the results in business undertakings has been most disastrous. Already several of the leading mines have closed down because the return on the output will not cover expenses, and there appears to be no prospect of re-starting, as under existing working and marketing conditions profitable production is out of the question. Although offers were made to the men that some of the mines would be kept going without any return to the shareholders, the men would not accept work at any reduced rate of wages.

West Australian Railways.

Although the gross earnings for the past year exceeded those of the previous year by £428,156, the loss on the year's working was £19,155 greater. Of the increased expenditure the Arbitration Court awards are responsible for £313,500.

Old Students' Dinner.—The second annual dinner of the Imperial College of Science and Technology Old Students' Associations was held at the Trocadero Restaurant on November 24th. As compared with last year's dinner it was quite a big function, there being some 160 people present, and the meeting was greatly brightened by the presence of a number of ladies. Although the dinner was not timed to start until eight o'clock, there was a large gathering by half-past seven, and the opportunity was seized on by the old students to renew acquaintances which too often in these days are allowed to lie dormant. The arrangement of the tables also was very pleasant, in this respect, as there were few which accommodated more than half a dozen guests. The speeches were, however, hardly fitted to the occasion, for they bordered more on the semi-political style than on the sociable or intimate character which many of those present thought would help better to foster that loyalty to the colleges which is the object of the Old Students' Association.

The Association of Consulting Engineers.—The annual dinner of the Association of Consulting Engineers, which had been postponed from the spring on account of the coal strike, was held at The Engineers' Club, Coventry-street, W. 1, on the 24th ult. It was a most successful and enjoyable function, as the dinners of that body always are. The gathering was under the chairmanship of Mr. W. Vaux-Graham, who is also the chairman of the Committee of the Association, which is unique in not having either a president or a paid officer. As an extra toast—not on the printed list—after that of "The King," the health of Princess Mary and her betrothed were enthusiastically drunk. The health of "The Association" was then proposed by Lord Meston, K.C.S.I., who, while extolling the work which engineers had done in the past, made it clear that much—at any rate in India—still remains to be done. The chairman having very briefly replied, Mr. S. R. Lowcock rose to propose the health of "The Legal Profession." The consulting engineer and the lawyer are continually in contact—and not infrequently at variance—one with the other, but it was perfectly evident from the speeches of the proposer and of Mr. Justice Shearman, who replied, that not only had the consequent familiarity not bred contempt, but that no feeling of rancour had been engendered; or if it had been, it had been effaced by the conviviality of the occasion. The toast of "Engineering Institutions" was, in the absence of Mr. H. J. Rofe, proposed by Mr. W. J. E. Binnie and responded to by Sir A. B. W. Kennedy, F.R.S., and Mr. J. S. Highfield, the new president of the Institution of Electrical Engineers; while the toast of "British Industry" was proposed by Mr. H. H. Dykes, the energetic secretary of the Association, and replied to by Sir Edward E. Pearson. Finally, the most important toast of the evening—as he himself designated it—was proposed by Mr. G. Midgley Taylor in a characteristic speech. Three guests responded: Sir John Snell—at one time himself a member of the Association, but now debarred by reason of his official position—Sir William Noble, the Chief Engineer to the Post Office; and Mr. G. M. Freeman, K.C.

Current Prices for Metals and Fuels.

IRON ORE.

N. W. COAST—	
Native	37/-
(1) Spanish	28/-
(1) N. African	28/-
N.E. COAST—	
Native	—
Foreign (c.i.f.)	27/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	6 7 6	—
No. 1 Foundry	6 7 6	—
No. 3 ,,	6 2 6	—
N.E. COAST—		
Hematite Mixed Nos.	5 10 0	5 10 0
No. 1	5 12 6	5 12 6
Cleveland—		
No. 1	5 5 0	5 10 0
Silicious Iron	—	—
No. 3 G.M.B.	5 0 0	5 5 0
No. 4 Foundry	4 15 0	4 15 0
No. 4 Forge	4 10 0	4 10 0
Mottled	4 5 0	4 5 0
White	4 5 0	4 5 0
MIDLANDS.		
Staffs.—		
All-mine (Cold Blast)	15 0 0	—
Part Mine Forge	*None offering.*	
,, Foundry No. 3	*None offering.*	
(3) Northampton—		
Foundry Nos. 2 and 1	*Nominal.*	
,, No. 3	4 12 6	—
,, Forge	4 5 0	—
(3) Derbyshire—		
No. 3 Foundry	4 15 0	
Forge	4 10 0	
Lincolnshire—		
Basic	*Uncertain.*	
Foundry	,,	
Forge	,,	—
(4) N.W. COAST—		
N. Lancs. and Cum.		
Hematite Mixed Nos.	6 15 0	—

MANUFACTURED IRON.

	Home. £ s. d.	Export £ s. d.
SCOTLAND—		
Crown Bars	12 10 0	—
Best ,,	17 0 0	—
N.E. COAST—		
Common Bars	12 10 0	—
Marked ,,	18 0 0	—
Tees	14 10 0	—
LANCS.—		
Crown Bars	13 0 0	—
Hoops	16 5 0	16 0 0
S. YORKS.—		
Crown Bars	13 0 0	—
Best ,,	14 0 0	—
Hoops	15 5 0	—
MIDLANDS—		
Marked Bars (Staffs.)	16 0 0	—
Crown Bars	13 0 0	—
Nut and Bolt Bars	13 0 0	—
Gas Tube Strip	15 0 0	—
Hoops	16 10 0	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	15 10 0	—
Ship Plates ¾in. and up	10 10 0	—
Sections	10 0 0	—
Steel Sheets ⅛in. to ⅜in.	12 15 0	—
Sheets (Gal. Cor. 24 B.G.)	—	13 0 0

STEEL (*continued*)

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	10 10 0	—
Angles	10 0 0	—
Boiler Plates	16 0 0	—
Joists	10 10 0	—
Heavy Rails	10 10 0	—
Fish-plates	15 10 0	—
Channels	14 10 0	—
Hard Billets	9 10 0	—
Soft Billets	7 10 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	11 0 0	—
Light ,,	13 0 0 to 15 0 0	
Billets	9 10 0	—
Ship Plates	10 10 0	—
Boiler ,,	16 0 0	—
MANCHESTER (*Prices irregular and uncertain, unchanged*)—		
(8) Bars (Round)	10 0 0 to 12 0 0	
(8) ,, (others)	11 0 0 to 12 0 0	
Hoops (Best)	15 5 0	15 0 0
,, (Soft Steel)	12 5 0	12 0 0
Plates	£10 to 12	10 0 0
,, (Lancs. Boiler)	16 0 0	
SHEFFIELD—		
Siemens Acid Billets	13 0 0	—
Bessemer Billets	12 10 0	—
Hard Basic	10 0 0	—
Soft ,,	8 10 0 to 10 0 0	
Hoops	13 5 0	—
Soft Wire Rods	10 0 0	—
MIDLANDS—		
Small Rolled Bars	10 10 0	—
Bessemer Billets and Sheet Bars	8 0 0	
(2) Hoops (Soft)	12 5 0	—
Tube Strip	11 10 0	—
Sheets (24 W.G.)	15 0 0	—
Galv. Sheets (f.o.b. L'pool)	18 0 0 to 19 0 0	
Angles	10 0 0	—
Joists	10 10 0	—
Tees	11 0 0	—
Bridge and Tank Plates	10 10 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	21/- to 22/6
Block Tin (cash)	163 5 0
,, (three months)	165 0 0
Copper (cash)	67 10 0
,, (three months)	68 10 0
Spanish Lead (cash)	26 0 0
,, (three months)	25 5 0
Spelter (cash)	26 7 6
,, (three months)	26 15 0
MANCHESTER—	
(9) Copper, Best Selected Ingots	69 10 0
(9) ,, Electrolytic	75 10 0
(10) ,, Strong Sheets	101 0 0
,, Loco Tubes	0 1 2½
Brass Loco Tubes	0 1 0½
,, Condenser	0 1 4½
Lead, English	27 0 0
,, Foreign	26 0 0

(*Metal prices practically unchanged*).

FERRO ALLOYS.

(*All prices now nominal*).

	Per Ton.	Per Unit
Tungsten Metal Powder	1/8 per lb.	
Ferro Tungsten	1/6 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£28	12/-
,, 6 p.c. to 8 p.c. ,,	£26	10/-
,, 8 p.c. to 10 p.c. ,,	£26	10/-
,, Specially Refined		
Max. 2 p.c. carbon	£79	28/-
,, 1 p.c. ,,	£94	32/-
,, 0·75 p.c. carbon	£110	41/-
,, carbon free	2/8 per lb.	
Metallic Chromium	5/6 per lb.	
Ferro Manganese (per ton)	£18 for home.	
,, Silicon, 45 p.c. to 50 p.c.	£12 10 0 scale 5/- per unit	
,, ,, 75 p.c.	£20 0 0 scale 6/- per unit	
,, Vanadium	21/- per lb.	
,, Molybdenum	9/- per lb.	
,, Titanium (carbon free)	1/6 per lb.	
Nickel (per ton)	£190	
Cobalt	14/6 per lb.	
Aluminium (per ton)	£110 to £120 (British Official).	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	25/-
,, ,, Ell	26/-
,, ,, Splint	26/6 to 30/-
,, ,, Trebles	24/6
,, ,, Doubles	21/-
,, ,, Singles	17/6
AYRSHIRE—	
(f.o.b. Ports)—Steam	24/-
,, ,, Splint	26/6
,, ,, Trebles	24/6
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	19/- to 23/6
Screened Navigation	29/-
Trebles	24/-
Doubles	20/6
Singles	18/6
LOTHIANS—	
(f.o.b. Leith)—Best Steam	22/6
Secondary Steam	22/-
Trebles	25/-
Doubles	22/-
Singles	17/6

ENGLAND.

(11) N.W. COAST—	
Steams	50/-
Household	40/- to 55/-
Coke	36/- to 39/6
NORTHUMBERLAND—	
Best Steams	24/- to 25/-
Second Steams	21/6 to 22/-
Steam Smalls	15/-
Unscreened	21/6
Household	28/- to 30/-
DURHAM—	
Best Gas	23/- to 24/-
Second ,,	20/- to 22/-
Household	25/- to 30/-
Foundry Coke	37/6 to 40/-
(12) SHEFFIELD—	
S. Yorks. Best Steam Hards	27/- to 29/-
Derbyshire Hards	26/- to 28/-
Seconds	25/- to 26/-
Cobbles	25/- to 26/-
Nuts	23/- to 24/-
Washed Smalls	17/- to 18/-
Best Hard Slacks	17/6 to 18/6
Seconds ,,	17/- to 17/6
Soft Nutty ,,	17/- to 17/6
Pea ,,	11/6 to 12/6
Small ,,	9/- to 10/-
House, Branch	39/- to 41/-
,, Best Silkstone	37/6 to 39/-
Blast Furnace Coke (Inland and Export)	22/6 to 27/6

(13) SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Smokeless Large	25/6 to 26/-
Second ,, ,,	25/- to 25/6
Best Dry Large	25/6 to 26/-
Ordinary Dry Large	24/6 to 25/-
Best Black Vein Large	23/6 to 24/6
Western Valley ,,	23/6 to 24/-
Best Eastern Valley Large	23/6 to 24/-
Ordinary ,, ,,	21/6 to 22/6
Best Steam Smalls	17/6 to 18/6
Ordinary ,,	12/6 to 17/-
Washed Nuts	32/6 to 35/-
No. 3 Rhondda Large	27/6 to 30/-
,, ,, Smalls	19/- to 20/-
No. 2 ,, Large	24/- to 25/-
,, ,, Through	20/- to 22/-
,, ,, Smalls	15/- to 16/-
Coke (export)	40/- to 45/-
Patent Fuel	26/- to 28/-
Pitwood (ex ship)	40/- to 42/6
SWANSEA—	
Anthracite Coals:	
Best Large	55/- to 57/6
Seconds	52/6 to 55/-
Red Vein	47/6 to 50/-
Big Vein	55/- to 57/6
Machine-made Cobbles	72/6 to 75/-
Nuts	72/6 to 75/-
Beans	58/6 to 60/-
Peas	24/- to 25/-
Breaker Duff	8/- to 8/6
Rubbly Culm	11/6 to 12/-
Steam Coals:	
Large	25/- to 27/6
Seconds	24/- to 25/-
Smalls	12/6 to 16/-
Cargo Through	20/- to 22/-

(1) Delivered. (2) Net Makers' works. (3) At furnaces. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.
(6) Home Prices—All delivered Glasgow Station. (7) Export Prices—F.O.B. Glasgow. (8) Prices represent the real market before the *official* change was made.
(9) These prices are practically alike now. (10) Sheets reduced while other prices are advancing.
(11) Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export and coke is per ton on rail at ovens and f.o.b. for export (12) For inland sales. (13) Per ton f.o.b.

French Engineering Notes.

(From our Correspondent in Paris.)

Commercial Reforms.

THE situation created by the restrictions imposed on trade by the legislation of the past three years is causing so much uneasiness all over the country that the Chambers of Commerce are constantly passing resolutions inviting the Government to remove the obstacles that stand in the way of trade development. Under normal conditions there is no doubt that the commercial situation would be by no means unsatisfactory. There is plenty of work to be done at home if only finances permitted of the many vast programmes of public works being put in hand, and there would be no lack of private enterprise if capitalists were assured that industrial undertakings could be carried out under conditions that would ensure an adequate return on their money. Unfortunately, there is no financial support at the present time for industrial enterprise of any kind. The idea is prevalent that the high wages, shorter working day and lower production have unduly increased the cost of everything, and that it is unwise to take an interest in industrial ventures unless something be done to bring about a more normal state of things. The fiscal policy has had disastrous results in almost entirely suspending business with certain countries. The recent strikes in the Nord, and the aggressive attitude of the labour leaders towards any modification of the present legislation affecting the men, are not reassuring. Nevertheless, all the commercial associations are insisting that something should be done to remove the present obstacles to trade expansion, notably by the suppression of the eight hours' day. The suppression is already contemplated in a Bill that will be presented to the Chamber of Deputies shortly, and although it will meet with considerable opposition from the labour element, the passing of the Bill will merely legalise a state of things that already exists, especially in the constructive engineering trades, where the men frequently work more than eight hours when required. The Chambers of Commerce are particularly insistent in their demands for facilities for carrying on business with other countries. If an interchange of goods is restricted by the present system of coefficients, it follows that there can be no improvement in internal finance, which depends largely upon the development and prosperity of home industries. The heavy shrinkage in the product of the tax on turnover as compared with the estimate is one of the causes of the financial embarrassment. The Government is believed to be contemplating another adjustment of import duties in the direction of facilitating trade, and until that is done the outlook is not encouraging.

Rail Cars.

Many systems of rail cars have been experimented with on the French railways from time to time, but in several cases they did not give satisfactory results because the engineers required too great a starting torque for the haulage of fairly heavy loads. On the Ouest-Etat Railway, where serious efforts are being made to realise economies, it is proposed to run rail cars on local lines where the traffic is light. During the past month trials have been carried out with a rail car on the line from Plaisir-Grignan to Epône-Mézières, near Mantes, the vehicle being an ordinary motor omnibus transformed for the purpose with cast iron wheels and the suppression of the differential gear. The car has been making a journey each way every day with one or two trailing coaches. The average speed is 25 kiloms. an hour, while the maximum speeds vary from 32 to 35 kiloms. In view of the satisfactory result of these tests the Ouest-Etat is having transformed a second-class coach with one-half of the body removed to provide for a 60 horse-power petrol engine with transmission to the front axle by chain. There will be a compressed air self-starter and a Westinghouse brake in addition to the ordinary motor car brakes. The remaining space will be used for luggage as well as by the driver. Two compartments will be available for sixteen second-class passengers, and the vehicle will haul a third-class coach for seventy passengers. As the average number of passengers carried is only forty, the proposed new service is regarded as amply sufficient. It is expected with this vehicle to attain a speed of 60 kiloms. an hour As regards the economies to be effected, the steam train costs 10f. a kilom., while the running cost of the motor vehicle is said to range from 3f. to 4f.

The State Merchant Fleet.

The fleet of merchant ships that was acquired by the State during the war has been disposed of under much better conditions than had been anticipated. Excluding the colliers, which will remain in the hands of the State for the time being, and the wooden vessels that were built in the United States and are regarded as having very little value, there were 400,000 tons for sale, and it was feared that the throwing of such a large quantity of shipping on the market would have had serious consequences in depreciating the prices obtainable. The Under-Secretary of State for the Merchant Marine succeeded, however, in grouping together shipowners who made a bid for the lot, the price, it is said, being quite favourable to the State and above that recently paid by Belgium for German vessels. The deal was carried out within three months of the passing of the Bill authorising the sale.

Constructional Work.

If the amount of business coming to the constructive engineering shops is small, there are nevertheless a good many orders for railway and bridge work, although none of the contracts is of large extent. The Ouest-Etat Railway is taking a lot of material for the important works being carried out in connection with the electrification of the Paris suburban lines. In the devastated regions tenders are being invited for the reconstruction of bridges, and now that Germany is preparing to fulfil her agreement to execute part of the reconstruction work, largely with French material, it is hoped that further contracts will be coming forward shortly.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

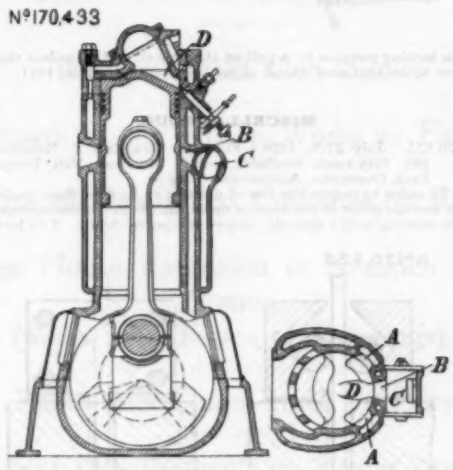
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

170,433. August 5th, 1920.—HOT BULB ENGINES, J. S. White and Co., Limited, East Cowes, A. Forster Bedeburn, Newport-road, Cowes, and G. A. Mellor, Strathmore, Park-road, Cowes.

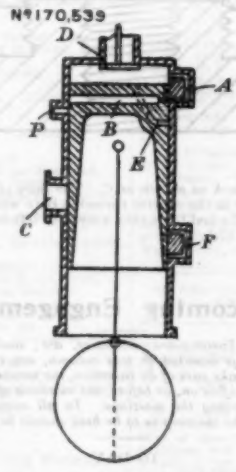
IN this engine there are three admission ports A A and B. The two ports A A communicate with the crank chamber, and are used to admit scavenging air when the piston nears the end of its stroke. The port B is for a supercharge of air, the admission of which is controlled by the oscillating valve C. When



the piston rises from the bottom of its stroke it shuts off the ports A A, but B remains open on account of the groove D formed in the top of the piston. This groove is also taken advantage of as a channel for the injection of the fuel into the combustion chamber.—*October 27th*, 1921.

170,539. June 15th, 1920.—TWO-STROKE ENGINES, F. L. Mädler, 115, Schillerstrasse, Charlottenburg, Germany.

This specification, which deals with two-stroke engines, reads as follows:—This invention relates to an improvement in the construction of internal combustion engines operating with liquid fuel, of the type in which combustion products are trapped in a chamber into which a charge of fuel is subsequently admitted and is vaporised by the heat of the said products, and is ultimately expelled by their pressure into the charge of air in the main cylinder. The construction is illustrated in vertical section in the accompanying drawing. Burned gases from the previous charge in the engine cylinder flow through the channel A into the chamber B, and the fuel charge is introduced through the pipe P by means of a pump directly into these hot gases, with which the fuel mixes intimately and is thereby completely

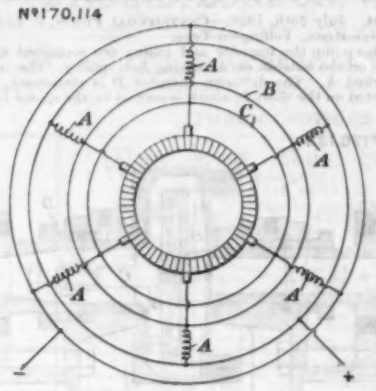


volatilised. When the piston in the engine cylinder has completed its out stroke and the burned gases have escaped through the outlet C in the usual manner, there follows the scavenging of the cylinder and the filling with fresh air through the valve D, the charge in the chamber B being meanwhile retained by the obturation of the channel E by the wall of the cylinder. The injection of the explosive mixture into the cylinder takes place as soon as the orifice of the conduit E coincides with the upper orifice of the conduit F. The fuel is thus delivered in exactly measured and regulated quantity, not directly into the main cylinder before vaporising, but already vaporised by prolonged previous contact with the hot walls of the chamber B, and with the hot gases therein, and, moreover, completely mixed and prepared for combustion.—*October 17th*, 1921.

DYNAMOS AND MOTORS.

170,114. July 14th, 1920.—IMPROVEMENTS IN AND RELATING TO DYNAMO ELECTRIC MACHINES, The British Thomson-Houston Company, Limited, of 83, Cannon-street, and Frank Purey Whitaker, of 237, Clifton-road, Rugby.

High voltage generators are sometimes provided with means for preventing flashing over at the commutator when a short-circuit occurs. Blow-out coils usually produce a magnetic field, which acts upon the arc and blows it away from the commutator. The windings of these coils are connected between the commutator brushes and the terminals of the machine, but owing to the inductance of the coils commutation is apt to be affected, and the object of the present invention is to prevent this by connecting all the brushes of one polarity to an equaliser connection and all the brushes of the opposite polarity to another connection situated between the commutator brushes and the blow-out coils. In the drawing the dynamo is provided with

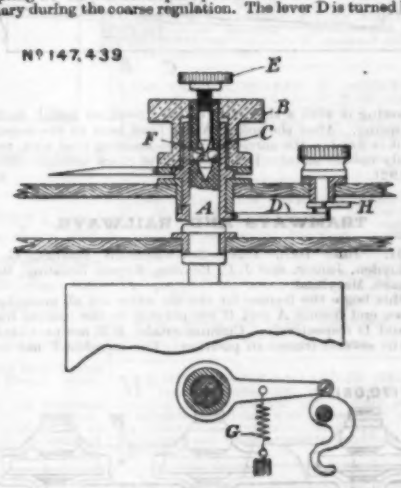


coils A adapted to produce a magnetic field to blow out any arc formed on the commutator. Between these coils and the commutator two equaliser connections B and C are arranged. Connection B is joined to all the positive brushes and connection C to all the negative brushes. Under these conditions the inductance of the blow-out coils will not affect commutation.—*October 14th*, 1921.

WIRELESS TELEGRAPHY.

147,439. July 7th, 1920.—COARSE AND FINE ADJUSTMENT SUITABLE FOR TUNING AND COUPLING DEVICES FOR WIRELESS TELEGRAPH APPARATUS, Gesellschaft für Drahtlose Telegraphie M.B.H., of 9, Tempelhofer Ufer, Berlin.

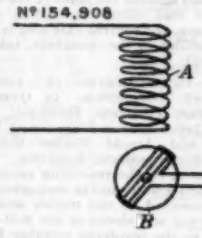
This invention relates to mechanism having a coupling or clutch by means of which the fine adjusting mechanism can be coupled or clutched to the coarse adjusting mechanism so that the latter can be operated independently of the former, but when the coupling is operative the device can be set by the fine adjustment. The part to be adjusted, such as a condenser or coupling coil, is turned by means of a spindle A. A knob B attached to this spindle serves for the coarse adjustment. A bush C on a lever D is situated between the knob B and spindle A, and can be coupled with the spindle A by means of a screw E and friction coupling F. In the uncoupled position the lever D remains stationary during the coarse regulation. The lever D is turned by the



fine adjusting mechanism, the lever being acted upon by a spring G which presses the lever against a cam H, which can be turned by the knob above. As long as the coupling F is inoperative the device may be adjusted coarsely with the aid of the knob B whilst the lever D is out of action. When an approximately correct position has been attained with the coarse adjustment, the screw E is screwed in, and the coupling F is thus brought into action. The latter locks the lever D to the bush C so that rotation of the right hand knob and the consequent movement of the lever D causes a slight rotation of the knob B. The movement is determined by the form of the cam H, and it is continued until the correct position is reached. The device is then left in this position, in which the coupling F serves to hold the coarse adjusting knob B and protects it from undesired movements.—*October 7th*, 1921.

154,908. December 3rd, 1920.—IMPROVED MEANS FOR REGULATING THE FREQUENCY OF ALTERNATING CURRENTS, Société Française Radio-électrique, of 9, Boulevard Haussmann, Paris.

When it is desired to avoid disturbances in the working of receivers utilising alternating currents it is in most cases of importance that the frequency of the currents should be kept constant, and particularly in wireless telegraph and telephone



systems employing the energy produced by high frequency alternators. The object of this invention is to provide a frequency regulator which shall be quick in action and highly sensitive. The regulator consists of a primary coil A traversed by the current derived from the generator and having a movable secondary B connected in series with a condenser C. Even the

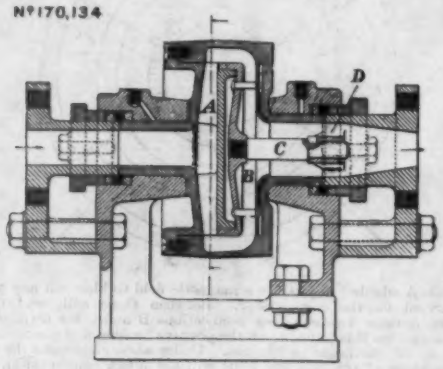
smallest variations in the frequency of the currents in the coil A produce considerable variations in the value of the couple. The coil B is therefore turned in one direction or the other from its position of equilibrium, and the movements are employed to regulate the speed of the motor which drives the generator.—*October 27th*, 1921.

PUMPING AND BLOWING MACHINERY.

170,134. July 20th, 1920.—Centrifugal Pumps, J. Little, 68, High-street, Felling-on-Tyne.

In this pump the impeller and casing are combined and are formed on the outside as a driving belt pulley. The impeller is marked A. The diffusion chamber B is stationary, and is supported on the shaft C, which is carried by the spider D in the

No 170,134



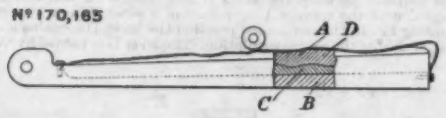
delivery branch. It is claimed that there is a minimum of loss through shock as the water passes through the pump, that there is no leakage back to the suction side, and that the bearings are water-cooled.—*October 20th*, 1921.

MACHINE TOOLS AND SHOP APPLIANCES.

170,165. August 19th, 1920.—Compensators for Lead Screws, A. Drummond, Ryde's Hill, Guildford.

In order to facilitate the manufacture of the cam plates used or compensating the errors in the lead screws of screw-cutting lathes, the inventor makes the cam plate of a bendable metal, such as hard tinman's solder, and prevents it being worn away

No 170,165



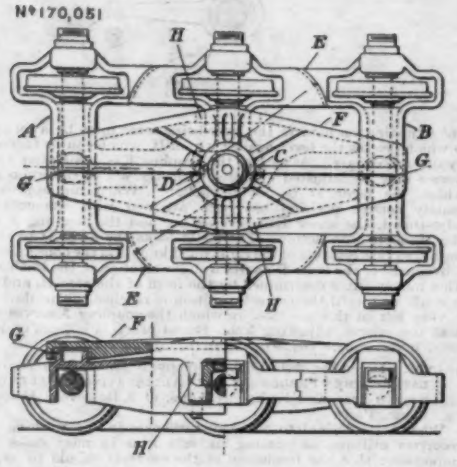
by covering it with a thin strip of hard resilient metal, such as clock spring. After the solder A has been bent to the required form, it is fixed in the carrier B with a backing C of wax, toffee or easily fusible metal. D is the strip of clock spring.—*October 20th*, 1921.

TRAMWAYS AND RAILWAYS.

170,051. June 10th, 1920.—Six-wheeled Bogies, G. A. Boyden, Junior, and J. C. Boyden, Keyser Building, Baltimore, Maryland.

In this bogie the frames for the six axles are all articulated. The two end frames A and B are pivoted to the central frame at C and D respectively. Circular guides E E are provided to keep the several frames in position. The member F has trun-

No 170,051

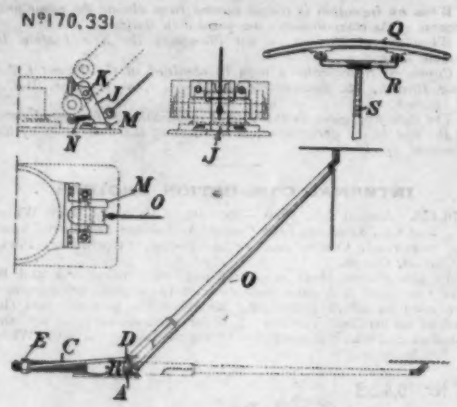


nions G G, which permit end play, but not side play, to connect it with the end frames, and bears against the sides of the central frame at H H. The result is that when the leading axle is deflected, on passing into a curve, the central axle also is partly deflected, and the bogie, according to the inventors, takes the curve easily.—*October 10th*, 1921.

170,331. June 17th, 1920.—Improvements in and Relating to Low-current Collectors in Overhead Wire Systems of Electric Traction, Brecknell, Munro and Rogers, Limited, of Thrissell-street Engineering Works, Thrissell-street, Bristol, and Arnold Morley Willis, of "Ventnor," Charlton Park, Keynsham, Somerset.

The trolley arm is hinged at A to the revolving member B, which is pivotally mounted on the base, and is supported in its raised position by links C connected to the trolley arm at D and to the sleeve E with a spring and sleeve in the well-known manner. A bolt J is pivoted to the revolving member B at K and is adapted to engage with a socket M on the base. A spring N holds the bolt in the socket. A rope O is attached to the bolt J and passed through an eye at the head of the pole. The bow Q is carried by a forked bracket R provided with a stem S adapted to telescope in the upper end of the pole. The bow is provided with lugs which are connected to the bracket R by bolts so that the bow can be tilted backwards or forwards and set to suit the elevation of the overhead wire. When it is required to swivel the pole for reverse direction of travel of the car or for other cause, the bolt of the spring-influenced catch is withdrawn from

No 170,331



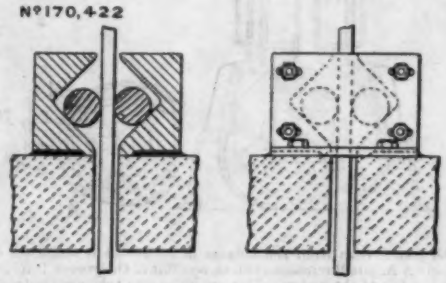
the locking position by a pull on the rope O, and the pole is then free to be swivelled round as required.—*October 17th*, 1921.

MISCELLANEOUS.

170,422. July 27th, 1920.—Furnace Dampers, F. Ringrose, 392, City-road, Sheffield, and J. MacBean Neil Temple Park Ironworks, Anniesland, Glasgow.

In order to reduce the loss of draught in furnace flues caused by leakage of air at the damper openings, the inventors surround the opening with a specially shaped casting as shown. Two loose

No 170,422

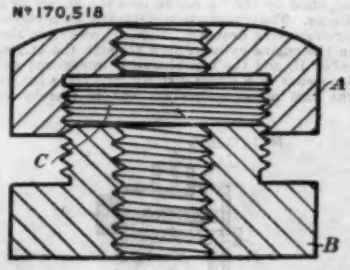


rollers are placed within the casting, one on either side of the damper, so that they tend to roll down the sloping faces of the casting and make a more or less air-tight joint.—*October 27th*, 1921.

170,518. December 17th, 1920.—A Lock Nut, J. W. P. Arrowsmith, 28, Verulam-avenue, Walthamstow, London, E. 17.

The lock nut consists of two parts A and B respectively. The projecting shoulder on B is threaded and screws into a corre-

No 170,518



sponding recess in A as shown at C. The bore of the recess C is slightly excentric to the central threaded bore which engages the bolt. The nut is locked by either a right or left-hand turn of the part B.—*October 27th*, 1921.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

Junior Institution of Engineers.—Caxton Hall, Westminster, S.W. 1. Lecturette, "Notes on Maintenance of Electrical Accumulators," by Mr. B. L. Ladkin. 8 p.m.

The Institution of Locomotive Engineers: Manchester Centre.—College of Technology, Manchester. Paper, "The Locomotive from a Footplate Point of View," by Mr. J. P. Grassick. 7 p.m.

The Sheffield Association of Metallurgists and Metallurgical Chemists.—Royal Victoria Hotel. Annual dinner. 7.30 p.m.

North-East Coast Institution of Engineers and Shipbuilders.—Literary and Philosophical Society, Westgate-road, Newcastle-on-Tyne. Paper by Sir Eustace H. T. d'Eyncourt. 6.30 p.m.

Institute of Marine Engineers.—Hotel Cecil, Strand, W.C. 2. Annual dinner.

FRIDAY AND SATURDAY, DECEMBER 2ND AND 3RD.

Northampton Polytechnic Institute.—St. John-street, E.C. 1. Annual prize distribution (Friday), and annual conversazione (Saturday). 7.30 p.m. Friday, 6.30 p.m. Saturday.

SATURDAY, DECEMBER 3RD.

Institution of British Foundrymen: Lancashire Branch.—College of Technology, Manchester. "Jar Ram Moulding Machines." 4 p.m.

MONDAY, DECEMBER 5TH.

University of London, University College: Faculty of Engineering.—Public lecture on "The Literature of Science," by Dr. A. Wolf. 5.30 p.m.

Junior Institution of Engineers.—Visit to works of Messrs. Duroglass in Blackhorse-lane, Walthamstow. 2.30 p.m. (Not Saturday, December 3rd, as announced last week.)

Society of Engineers.—Geological Society, Burlington House, Piccadilly. Paper: "Northwich Sewerage and Sewage Disposal Works," by Mr. W. M. Beckett. 5.30 p.m.

Royal Society of Arts.—John-street, Adelphi, W.C. 2. Cantor Lecture II.: "Processes of Engraving and Etching," by Mr. A. H. Hind. 8 p.m.

Royal Institution of Great Britain.—Albemarle-street, Piccadilly, W. 1. General meeting. 5 p.m.

Institution of Locomotive Engineers: Leeds Section.—Y.M.C.A., Albion-place, Leeds. "The Locomotive from a Footplate Point of View," by Mr. J. P. Grassick. 7 p.m.

Institution of Electrical Engineers.—Savoy-place, Victoria Embankment, W.C. 2. Informal meeting. Discussion: "Some Recent Developments in the Design of Alternating-current Instruments," to be opened by Mr. C. L. Lipman. 7 p.m.

TUESDAY, DECEMBER 6TH.

Junior Institution of Engineers: Midland Section.—Chamber of Commerce, New-street, Birmingham. Presidential address by Mr. R. B. Askquith Ellis. 7 p.m.

Institution of British Foundrymen: Lancashire (Burnley) Branch.—Technical College, Burnley. "Foundry Problems," by Mr. W. H. Cook.

Institute of Marine Engineers.—The Minories, Tower Hill, E. 1. "Weather at Sea, including Clouds, Waves, &c.," by Sir D. Wilson-Barker. Lantern, ladies' night. 6.30 p.m.

Institute of Metals: Birmingham Local Section.—Chamber of Commerce, New-street, Birmingham. "The Early History of Copper and Bronze," by Mr. Geo. W. Mullins. 7.30 p.m.

Royal Society of Arts: Dominions and Colonies Section.—John-street, Adelphi, W.C. 2. "British Columbia: The Awakening of the Pacific," by Mr. F. C. Wade. 4.30 p.m.

The Women's Engineering Society.—Club Room, 26, George-street, Hanover-square, W. "The Use of Home-produced Fuels for Commercial Motor Transport," by Mr. T. Clarkson. 6.15 p.m.

WEDNESDAY, DECEMBER 7TH.

Institution of Railway Signal Engineers.—Midland Grand Hotel, St. Pancras. Resumed discussion on paper, "Three-position Signalling," by Mr. A. E. Tattersall. 6 p.m.

Institution of Sanitary Engineers.—Caxton Hall, Westminster, S.W. 1. "Town Planning," by Mr. S. A. Hill-Willis. Lantern. 7 p.m.

Institution of Electrical Engineers: Wireless Section.—Savoy-place, Embankment. "An Investigation of Transmitting Aerial Resistances," by Mr. T. L. Eckersley. 6 p.m.

Royal Society of Arts.—John-street, Adelphi, W.C. 2. "Literature and International Relations," by Emile Cammaerts. 8 p.m.

Institution of Heating and Ventilating Engineers.—College of Technology, Manchester (Room E 17). Paper: "Notes on Air Measurement," by Mr. E. R. Dolby. Lantern. 2.30 p.m.

Northampton Engineering College: Engineering Society.—St. John-street, Clerkenwell, E.C. 1 (Room 102). Paper: "Efficiency of Combustion," by Mr. V. R. Chadwick. 5.30 p.m.

THURSDAY, DECEMBER 8TH.

Institute of Metals: London Local Section.—Institute of Marine Engineers, 85–88, The Minories, Tower Hill, E. 1. "Casting in Metal Moulds," by Mr. S. A. E. Wells. 8 p.m.

The Optical Society.—Imperial College of Science and Technology, South Kensington, S.W. 7. "The Physical Meaning of Spherical Aberration," by Mr. L. C. Martin; "An Autostroboscope and an Incandescent Colour Top," by Dr. F. Lloyd Hopwood; "Achromatic One Radius Doublet Eyepieces," by Lieut.-Colonel Gifford. 7.30 p.m.

East London College: Department of Civil and Mechanical Engineering.—Mile End-road, E. 1. Lecture VII. on "Diesel and Semi-Diesel Oil Engines, the Present Position of the Heavy Oil Engine and the Problems Involved in its Further Development," by Engineer-Commander B. W. Knott. 6 p.m.

Association of Managers of Sewage Disposal Works.—Holborn Restaurant, London. Annual general meeting and annual dinner. 2.30 p.m., Presidential address by Mr. Joseph Garfield. Papers: "Comparative Methods of Lifting Sewage," by Mr. P. G. Lloyd; "Notes on Keeping Records and Accounts of Sewage Disposal Works," by Mr. Percy Lamb. 6.30 p.m., annual dinner.

FRIDAY, DECEMBER 9TH.

Institution of Mechanical Engineers.—Storey's-gate, Westminster. Informal meeting. Discussion, "Ball and Roller Bearings: Some Recent Types and Criticisms," continued from last session. 7 p.m.

West of Scotland Iron and Steel Institute.—24, Royal Technical College, George-street, Glasgow. "Modern Steam Generators for the Efficient Utilisation of Gaseous Fuels and the Efficient Recovery of Waste Heat," by Mr. Percy S. G. Kirk. 7 p.m.

Junior Institution of Engineers.—Royal United Services Institution, Whitehall. Presidential address by Mr. C. H. Wordingham. 7.30 p.m.

Association of Managers of Sewage Disposal Works.—Visit to the Kingston-on-Thames sewage disposal works at 11 a.m.

Manchester Association of Engineers.—Memorial Hall, Albert-square, Manchester. Paper: "The Water Power of Great Britain and the Empire," by Sir Dugald Clerk. 7 p.m.

Association of Engineering and Shipbuilding Draughtsmen: Merseyside Branch.—University Engineering Building, Liverpool. "The Future Relations between Great Britain, Japan and U.S.A.," by Mr. C. C. Stevenson. 7.30 p.m.

SATURDAY, DECEMBER 10TH.

Scientific Society of the Royal Technical College, Glasgow.—Lecture: "Water Turbines," by Mr. D. M. Anderson. 7.30 p.m.

TUESDAY, DECEMBER 13TH.

The Faraday Society.—Rooms of Chemical Society, Burlington House, W. 1. Annual general meeting. Address on "The Structure of Some Gaseous Molecules," by Professor A. O. Rankine. To be followed by a discussion. 7.45 p.m.

Manchester Metallurgical Society.—The College of Technology, Manchester. "White Metals," by Mr. A. H. Munday. 7 p.m.